DISCUSSION DRAFT

PARTIAL EXPLORATION PLAN
ENVIRONMENTAL BASELINE DATA COLLECTION AND MONITORING ELEMENT

FEDERAL OIL SHALE PROTOTYPE LEASING PROGRAM
TRACTS U·a AND U·b , UTAH

TRACT U-a

SUN OIL COMPANY
P.O. BOX 2880
SOUTHLAND CENTER
DALLAS , TEXAS

AND

PHILLIPS PETROLEUM COMPANY
786 FRANK PHILLIPS BUILDING
BARTLESVILLE , OKLAHOMA 74003

TRACT U-b

WHITE RIVER SHALE OIL COMPANY
300 ENTERPRISE
GRAND JUNCTION , COLORADO 81501

TN
859
.U82
W445
1974
draft

88064782

TN
859
.U82
W445
1974
draft
c.1

DISCUSSION DRAFT

PARTIAL EXPLORATION PLAN
ENVIRONMENTAL BASELINE DATA COLLECTION AND MONITORING ELEMENT

BLM Library
D-553A, Building 50
Denver Federal Center
P. O. Box 25047
Denver, CO 80225-0047

FEDERAL OIL SHALE PROTOTYPE LEASING PROGRAM
TRACTS U-a AND U-b UTAH

TRACT U-a

SUN OIL COMPANY
AND
PHILLIPS PETROLEUM COMPANY

TRACT U-b

WHITE RIVER SHALE OIL COMPANY

JUNE 12, 1974

TABLE OF CONTENTS

Page

I. INTRODUCTION 1

A. GENERAL 1

B. THE PLAN 1

C. DEVELOPMENT GOAL 4

D. PERMITS AND APPROVALS 5

II. GEOLOGIC EXPLORATION 6

III. LOCATION AND DESCRIPTION OF OIL SHALE PROPERTIES 7

IV. PRE-EXPLORATORY ENVIRONMENTAL INVESTIGATIONS 10

V. ENVIRONMENTAL BASELINE DATA COLLECTION AND MONITORING PROGRAM 12

A. WATER RESOURCES 12

1. Surface Hydrology 12

2. Groundwater Hydrology 19

B. AIR RESOURCES 23

1. Air Quality 24

2. Meteorology 35

C. BIOLOGICAL RESOURCES 42

1. Vegetation 42

2. Wildlife 44

3. Aquatic Ecology 53

4. Ecosystem Analysis 60

Page

D. GEOLOGY AND SOILS. 62

1. Geologic Investigations 62
2. Soils Survey and Productivity Assessment. . . . 63
3. Seismicity. 68

E. HISTORIC, SCIENTIFIC, AND AESTHETIC RESOURCES. . . . 70

1. Archaeologic Survey 70
2. Paleontologic Survey. 71
3. Historic Sites Survey 72
4. Aesthetic Values. 72

F. AERIAL PHOTOGRAPHY AND TOPOGRAPHIC MAPPING 73

VI. A. ENVIRONMENTAL SITE SELECTION PROCESS 75

B. WASTE MANAGEMENT PROGRAM 76

1. Solid Waste 76
2. Liquid Waste. 76
3. Sanitary Waste Disposal 77

C. NOISE MONITORING 78

VII. SITE FACILITIES 79

A. SITE PREPARATION AND CONSTRUCTION. 79
B. ACCESS ROADS REQUIREMENTS. 81
C. CORRIDOR PLANNING 83
D. OFF-SITE FACILITIES. 85
E. SAFETY, FIRE PREVENTION, AND OTHER CONTROL MEASURES. 86

Page

VIII. INITIAL FISH AND WILDLIFE MANAGEMENT PLAN 89

IX. SURFACE REHABILITATION AND EROSION CONTROL PLAN 92

A. SURFACE REHABILITATION 92

B. EROSION CONTROL 93

X. SCHEDULE OF MANPOWER REQUIREMENTS 95

LIST OF PLATES

Page

1. Location Map of Project Area 10

2. Boundaries of Oil Shale Tracts 11

LIST OF TABLES

Page

1. Surface water Quality Analytical Program 17

2. Program Schedule and Manpower Requirements 96

NOTE TO REVIEWER

This document is a draft outline of a proposed joint Environmental Baseline Data Collection and Monitoring Program for both Federal Oil Shale Prototype Lease Tracts U-a and U-b. This material is provided solely for the purpose of (i) advising interested parties of the extent and parameters of the environmental program currently under consideration, and (ii) soliciting comments and recommendations on the program for incorporation in the final Environmental Baseline Data Collection and Monitoring Plan Element of the Exploratory Plan which will be formally submitted to the Office of the Oil Shale Mining Supervisor for review and approval on or about July 1, 1974.

This is not to be construed as formal submittal, since no approvals are being requested at this time and none are expected.

Questions and comments may be directed to the following:

Mr. Douglas M. Ross, or
Mr. John Lane, or
Mr. Steve McCutcheon
6875 E. Evans Avenue
Denver, Colorado 80120
Tel: (303) 759-4271

SECTION I

INTRODUCTION

FEDERAL OIL SHALE PROTOTYPE LEASING PROGRAM
TRACT U-a and TRACT U-b
PARTIAL EXPLORATION PLAN

ENVIRONMENTAL BASELINE DATA COLLECTION AND MONITORING PROGRAM ELEMENT

SECTION I

INTRODUCTION

A. GENERAL

This Partial Exploration Plan draft (referred to as the "Plan") has been prepared jointly by the Operators for Tracts U-a (Sun Oil Company and Phillips Petroleum Company) and U-b (White River Shale Oil Corporation) pursuant to Section 10 (d) of the respective Oil Shale Leases U-25918 and U-26194.

This Partial Exploration Plan is specifically directed toward the activities relating to the Environmental Baseline Data Collection and Monitoring Program and the requirements associated therewith. As such, it does not include the Geologic Exploration Element which must be ultimately implemented to define the oil shale resources of the tracts.

B. THE PLAN

This Partial Exploration Plan details the two (2) respective operators' plans for implementing a coordinated environmental program on both Tracts U-a and U-b. This program, which includes collecting baseline data and establishing comprehensive environmental monitoring activities to be conducted through the initial two-year period, will clearly define and document the environmental conditions that exist on the tracts prior to any development. This will provide the essential predevelopment planning information which, along with engineering the economic data, will provide a basis for the physical planning and design of oil shale mining and processing facilities and preparation of the Detailed Development Plan.

The program proposed to be conducted on and adjacent to the tracts includes:

(1) Pre-Exploration Environmental Investigations;

(2) Environmental Baseline Data Collection and Monitoring Programs, including:

  - ° Surface and Ground Water Resources Investigation and Sampling
  - ° Air Quality and Meteorological Monitoring
  - ° Biological Resources Investigation
  - ° Geology, Soils and Seismicity Surveys

In addition to these environmental programs, the Operators have included preliminary plans for fish and wildlife management, erosion control, surface rehabilitation, and site facilities, as well as other special interrelated program activities. These are initially applicable to the environmental and related exploratory field work and, as such, are subject to refinement as the environmental program proceeds, ultimately resulting in complete and final long-range plans, which will be included in the Detailed Development Plan submittal. Support activities such as aerial photography and topographic mapping techniques also are described, as related to basic mapping procedures, photogeology and biological monitoring.

It is intended that continuous monitoring of selected environmental parameters will be conducted throughout the development phase and subsequent to the cessation of operations to provide:

(i) a continuing record of environmental changes from conditions existing prior to any development, as established by the initial baseline data program;

(ii) a continuing verification of compliance with provisions of the lease and applicable environmental protection and pollution control requirements;

(iii) immediate elucidation of detrimental effects and conditions requiring correction; and

(iv) a factual basis for possible revision or amendment of the lease stipulations.

This Partial Exploration Plan may be supplemented or modified as indicated by analyses of data gathered. However, any such revisions or amendments will be implemented only after approval is obtained from the Office of the Oil Shale Mining Supervisor, in compliance with the lease stipulations.

The environmental program element presented in this plan will constitute a significant portion of the total effort during the next two and one-half (2½) years. Requirements relating to water resources, meteorology, and air quality are reasonably well defined at this time and can be initiated almost immediately upon formal submittal and approval of the Exploratory Plan. Biological studies and archaeology-paleontology investigation can be initiated soon after completion of pre-exploratory site surveys (non-destructive field walk-throughs and aerial photography operations).

In compliance with the lease regulations, none of the field investigative or data collection efforts proposed herein are considered to be an integral part of the Detailed Development Plan itself, nor will any subsequent geologic exploration work that may be required to collect resource data.

The scope of the proposed environmental program and the methodologies to be employed in conducting the program will be coordinated with interested local, State, and Federal agencies and other influencing groups to insure coordination of this program with any related activities planned or currently underway by those bodies. Further, these groups will be advised of the progress and results of the environmental program on a continuing basis through the life of the activity.

C. DEVELOPMENT GOAL

1. It is the mutual intent of the respective lease operators (Sun Oil Company-Phillips Petroleum, and White River Shale Oil Corporation) to develop commercial shale oil mining and synthetic petroleum processing facilities on or near the proposed tracts at the earliest date feasible. Consistent with this goal, the sponsoring companies anticipate submitting the Detailed Development Plan (DDP) in late 1976. It is therefore essential that the Environmental Baseline Data Collection and Monitoring Program be: (i) implemented, sustained, and completed at the earliest feasible date to insure maintenance of

the program timing, and (ii) that the methodologies selected for collection, documentation, analysis, and reporting of the data be of such relevance as to insure the early concurrence and approval by the Office of the Oil Shale Mining Supervisor and other permitting and influencing agencies.

D. PERMITS AND APPROVALS

A thorough investigation will be made of all permit requirements and approvals pertaining to the proposed monitoring and data collection activities. These would include drilling permits, approval of discharge from pumping tests, and Bureau of Land Management requirements concerning access road construction, power line extensions and other activities. All other necessary procedures and appropriate approvals will be obtained as applicable to the Partial Exploration Plan.

SECTION II

GEOLOGIC EXPLORATION

SECTION II

GEOLOGIC EXPLORATION

Core hole drilling information obtained during the nomination stage of the prototype oil shale leasing program is just now becoming available to the lease holders. Analysis of this existing resource data by competent geologists, hydrologists, and mining engineers will be necessary before an additional coring program can be fully defined and a geologic exploration plan developed.

The pre-exploratory survey of the lease areas, under way at the present time, will provide data on environmentally sensitive areas not conducive to core hole drilling operations. Exact locations for drilling operations will be surveyed by the operator's engineers, along with involved State and Federal agencies. Wherever possible, multi-functional holes will be drilled to provide data for resource evaluation, hydrologic testing, soils surveying, and rock mechanics, etc. This procedure will save time and will minimize the number of drill sites and consequent surface disturbance.

The drilling program and other exploratory and research operations necessary to obtain complete resource data will be described in a later supplemental plan to be filed with the Office of the Oil Shale Mining Supervisor.

SECTION III

LOCATION AND DESCRIPTION OF OIL SHALE PROPERTIES

SECTION III

LOCATION AND DESCRIPTION OF OIL SHALE PROPERTIES

This Partial Exploration Plan applies to both Tract U-a and Tract U-b of the Federal Oil Shale Prototype Leasing Program. General tract location is indicated in Plate 1, with respective tract boundaries delineated on Plate 2. The respective tracts include the following areas:

Tract U-a

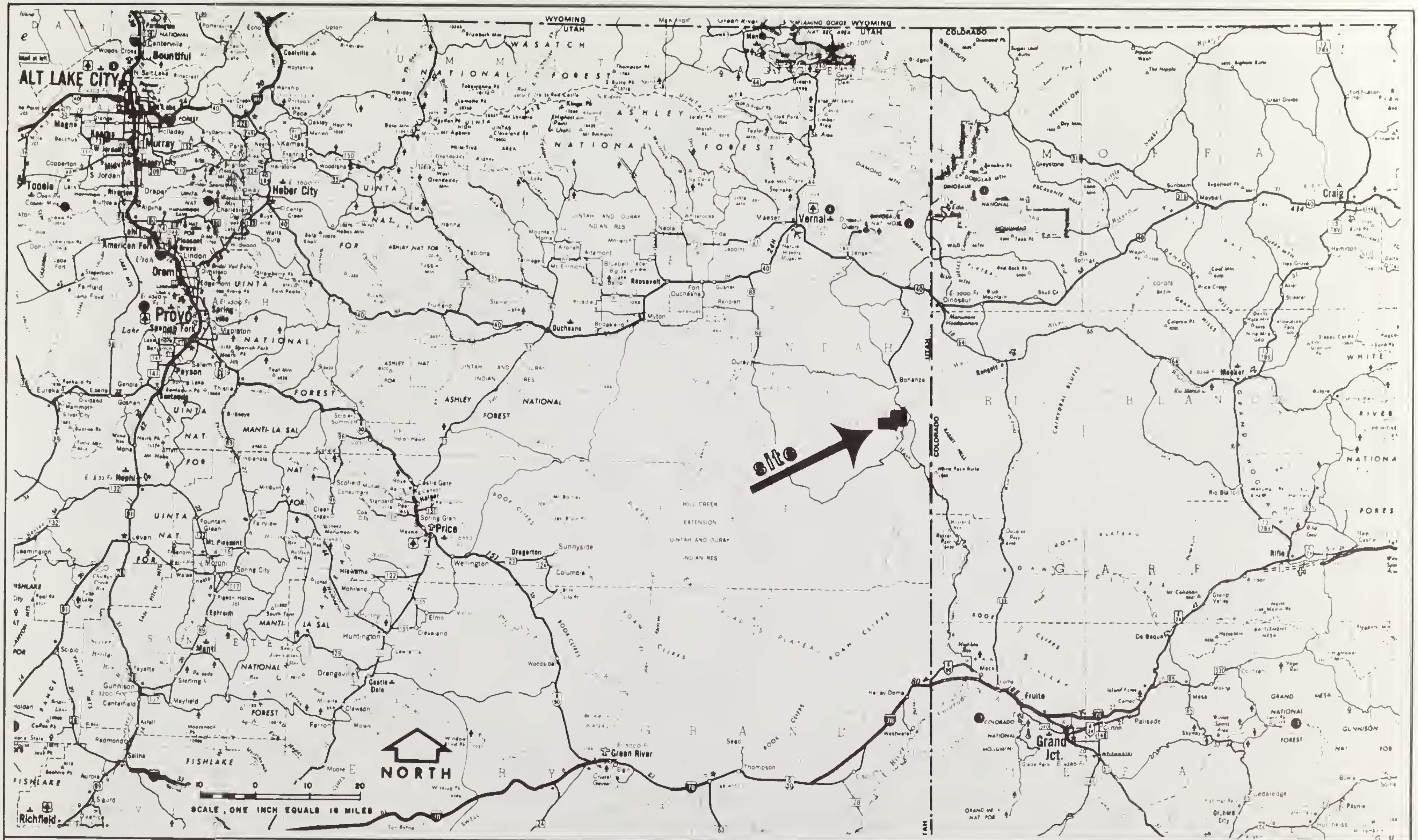
T. 10 S., R. 24 E., Salt Lake Meridian
  Sec. 19, E 1/2
  Sec. 20, all;
  Sec. 21, all;
  Sec. 22, all;
  Sec. 27, all;
  Sec. 28, all;
  Sec. 29, all;
  Sec. 30, E 1/2;
  Sec. 33, N 1/2;
  Sec. 34, N 1/2.

(The area described aggregates 5,120.00 acres.)

Tract U-b

T. 10 S., R. 24 E., Salt Lake Meridian
  Sec. 12, S 1/2, S 1/2 N 1/2;
  Sec. 13, all;
  Sec. 14, all;
  Sec. 23, all;
  Sec. 24, all;
  Sec. 25, W 1/2 W 1/2;
  Sec. 26, all.
T. 10 S., R. 25 E., S.L.M.
  Sec. 18, all;
  Sec. 19, all;

(The area described aggregates 5,120.00 acres.)

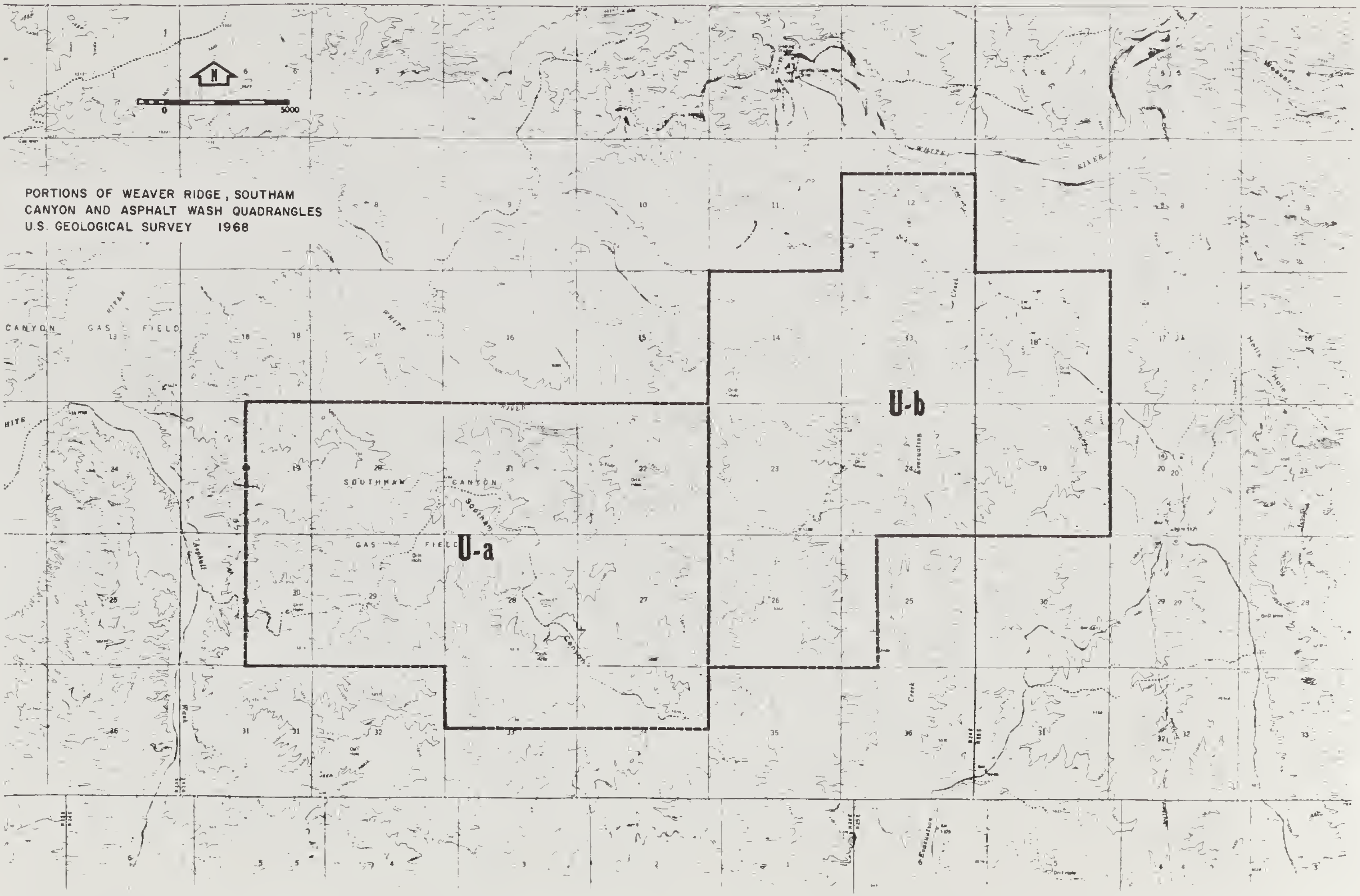


VTN

LOCATION MAP OF PROJECT AREA

TRACTS U-a AND U-b

PLATE 1



PORTIONS OF WEAVER RIDGE, SOUTHAM
CANYON AND ASPHALT WASH QUADRANGLES
U.S. GEOLOGICAL SURVEY 1968

vtn

BOUNDARIES OF OIL SHALE TRACTS
U-a & U-b

PLATE 2

SECTION IV

PRE-EXPLORATORY ENVIRONMENTAL INVESTIGATIONS

Have they started on this
if not [illegible] should [illegible]
[illegible] incidental [illegible]

SECTION IV

PRE-EXPLORATORY ENVIRONMENTAL INVESTIGATIONS

The lease operators propose to conduct preliminary investigations of monitoring programs (prior to the initiation of specific environmental data collection activities) to validate proposed program plans and schedule future needs and activities in such a manner as to avoid undue environmental damage from the Exploration Program. These investigations are non-destructive and are not substitutes for the required environmental baseline data collection and monitoring programs, but are supplements thereto. The principal areas of preliminary field investigations planned pertain to:

(1) Biological Resources
  - Plant and animal ecology
  - Aquatic ecology

(2) Historic and Scientific Resources
  - Archeology
  - Paleontology
  - Historic Sites

(3) Meteorology and Climatology

(4) Surface Hydrology

The main objective of these initial walk-throughs and preparations to obtain color aerial photography is to provide adequate environmental data prior to the exploratory disturbances contemplated to avoid and mitigate surface disturbance or destruction of environmental values. The plant and animal survey will provide background on the type and conditions of flora and fauna existing on the areas which may be most sensitive to disturbance. The information will assist in the planning of facility locations and monitoring sites, access routes, etc. A preliminary field assessment will identify any rare or scientifically significant species or special features of interest such as springs or objects of historic interest. The Mining Supervisor will be immediately informed of any such species or special features found. Surface water quality samples will be taken, but no soil samples, vegetation species or other items are to be removed from the tracts until the formal plan is approved.

SECTION V

ENVIRONMENTAL BASELINE DATA COLLECTION AND MONITORING PROGRAM

SECTION V

ENVIRONMENTAL BASELINE DATA COLLECTION AND MONITORING PROGRAM

The scope, methodology, organization, timing, objectives, and on-site equipment related to the environmental data collection and monitoring programs proposed to be carried out on the lease tracts are described herein.

A. WATER RESOURCES

1. SURFACE HYDROLOGY

Lease stipulations as outlined by the Bureau of Land Management, "Modification of Oil Shale Withdrawal in Colorado, Utah and Wyoming," requires the following surface water baseline monitoring program:

- °Gaging stations shall be constructed on the major drainages...and, as required by the Mining Supervisor, upstream and downstream from the lease lands.
- °Data collected at the stations shall include continuous stream level, specific conductivity and water temperature records.
- °Periodic analyses for selected inorganic and organic chemical constituents.

The system of water quality monitoring and stream gaging stations described below is designed to meet and often exceed these requirements and to afford additional capability to detect any adverse effects caused by the related oil shale development activities which take place off the two tracts.

The location of sampling and stream gaging stations will be selected to provide data from the significant water courses which could be affected by shale oil development on Tracts U-a and U-b.

water monito
stations t
sub pla

Final selection of the necessary upstream and downstream water quality and stream flow stations will be done after consultation with representatives of the Utah District Water Resource Division of the USGS and with the approval of the Mining Supervisor. Site visits with the USGS will enable the exact locations of these monitoring stations to be marked in the field. Criteria for the positioning of these stations will be based on a number of factors:

°Environmental considerations (adverse impacts, etc.)
°Size of watersheds or stream
°Seasonal accessability
°Configuration of stream channel
°Location of potential spent shale disposal sites
°Position of watershed in relation to the tracts and the related surface development

The design and construction of these stations and the selection of equipment for monitoring the various water parameters will be done under the supervision of the USGS.

If possible a cooperative program will be undertaken with the Utah District of the USGS to supervise the stream gaging, weather station and water quality monitoring program. In this program, the lease operator's hydrologists would be designated as "local observers" to assist the USGS field crews in equipment calibration, maintenance, stream gaging, water quality sampling, and collection of precipitation data. All continuous records on water stage, water temperature, conductivity and precipitation would be collected and maintained by the USGS in Salt Lake City.

a. Methodology

All stream gaging stations will be equipped to continuously record water level (stage) fluctuations. Every water quality station will be equipped to continuously record water temperature and conductivity. Critical water quality stations such as those on the White River and Evacuation Creek will be equipped with ETR pumped sediment samplers and turbidimeters. Until the equipment can be obtained to stock these monitoring stations, a rigorous grab sample program will be employed to collect representative background data. Daily water samples will be collected for temperature, conductivity and suspended solids. Sampling and analysis programs will include the following:

Trace Elements

Development of the oil shale will require the removal, processing and disposal of vast quantities of oil shale. Consequently, background or baseline data on the concentrations of these constituents in both ground water and surface water must be determined if the impact of development on water quality is to be assessed.

Trace elements to be analyzed for in the program should include: arsenic, barium, berylium, boron, cadmium, copper, chromium, mercury, lead, lithium, selenium, manganese, silver, molybdenum, tin, and zinc. Sufficient surface water samples should be collected to define variations in the above constituents with streamflow which will require sampling at various streamflow conditions in addition to specified time intervals.

underl
items s
not c
Summar
Page

Inorganic Chemicals

Analysis will be conducted under the inorganic chemical program for the standard list of cations and anions, alkalinity, total dissolved solids, suspended solids, pH, turbidity, color, odor, nitrates, nitrites, organic nitrogen, ammonium, nitrogen, and total phosphate. Initially it is planned to perform these tests twice a month on samples from all stations. After the first year of monitoring, it may be possible to reduce this program and sample on a less frequent period.

Organic Constituents

Virtually no background information exists on the occurrence and distribution of organic constituents in the surface and nd water of the Uinta Basin. Therefore, the initial sampling program should be a screening program to identify those groups of organic components that have the greatest solubility in water. This would include members of the following reactive groups: acids, alcohols, aldehydes, ketones, poly hydroxy compounds, phenols, bases, amines, and sugars. In addition, the polycyclic aromatics, petroleum and starch groups of organic compounds should be considered because of the large volume of material that will be handled in the oil shale area.

underline
items
not on
sum
Pa

The seasonal variation of these constituents is not known; therefore, ground water should be sampled quarterly and streams over the entire range of discharge and seasons to define the variation.

Measurements of biochemical oxygen demand, dissolved organic carbon, and suspended organic carbon can be used as indicators of gross changes in the functional groups listed above. These measurements can be used to determine if changes in the background organic chemistry have occurred. If changes are found then analyses can be run to determine which of the above groups have changed. Table 1 summarizes the surface water analytical program.

Sediment Program

In any mining environment there is a potential for discharge of large amounts of particulate matter in streams. A sampling program to define the suspended-sediment discharge of streams draining the oil-shale area should be initiated. Suspended-

lets get uniform
list we require

TABLE 1

SURFACE WATER QUALITY ANALYTICAL PROGRAM

	All Surface Waters	
	Semi-Monthly	Semi-Annually
Specific Conductivity	x	
Dissolved Solids	x	
Suspended Solids	x	
Dissolved Oxygen	x	
pH	x	
Turbidity	x	
Color	x	
Odor	x	
Silica	x	
Calcium	x	
Magnesium	x	
Sodium	x	
Potassium	x	
Ammonia	x	
Cyanide	x	
Sulfate	x	
Sulfide	x	
Nitrate	x	
Nitrite	x	
Phosphate	x	
Chloride	x	
Carbonate	x	
Bicarbonate	x	
Fluoride	x	
Lithium	x	
Barium	x	
Chromium	x	
Arsenic	x	
Selenium	x	
Cadium	x	
Copper	x	
Boron	x	
Iron	x	

	All Surface Waters	
	Semi-Monthly	Semi-Annually
Lead	x	
Manganese	x	
Silver	x	
Zinc	x	
Complete Element Scan for all trace elements		x
Gross Alpha*		x
Gross Beta*		x
COD	x	
BOD	x	
Oil & Grease (Petroleum)	x	
Carbon Chloroform Extract	x	
Coliform, Total and Fecal	x	
Alkyl Benezene Sulfonate	x	
Phenols	x	
Amin~~os~~es		x
Polycyclic Aromatics		x
Pesticides		x
Asbestos		x
Mercury	x	
Berylium	x	
Molybdenum	x	

Missing inorganics
Tin - see p 15
Alkalinity - " [illegible]
organic nitrogen - "
Ammonium - "
Nitrogen - "

Missing organics
Acids - see p 16
Alchols - "
Aldehydes - "
Ketones - "
Poly hydroxy compounds -
bases - "
sugars - "
starch - "
desolved organic
Suspended organic

*Depending on count, thorium 230, radium 226, strontium 90 and natural uranium may be required.

Missing here but in Cb approval
total hardness
hydroxide +
Alumnum
Free Cl_2

sediment concentration increases as a result of increased streamflow and the associated increased convergence and turbulence.

ETR pumping sediment samplers, turbidimeters and daily grab samples will be used to define the sediment characteristics of the White River and other flowing streams on the two tracts. Grab sample programs can be effectively employed to measure the suspended solids at several depths and at different locations within any stream cross-section.

A special program of bed sediment sampling at every water quality station will be employed four times a year. Bottom sediment samples will be collected and analyzed for; mineralogy, particle size distribution, and color photo micrographs.

Aquatic Macroinvertebrates

Aquatic macroinvertebrates can serve as an excellent integrating indicator of water quality. It is essential that the numbers of individuals and species of periphyton and aquatic macroinvertebrates be defined for streams in their existing conditon and be monitored as the oil-shale industry develops to document any changes. Changes in the biotic community will reflect changes in water chemistry. Natural changes in water chemistry occur with changes in streamflow. Consequently, the aquatic macroinvertebrates should be sampled seasonally to determine the natural variation. Measurements of pH. temperature, and

See V. M. Wright for something in addition ?

specific conductance as well as samples for trace element analyses must be made in conjunction with the macroinvertebrate samples.

2. GROUNDWATER HYDROLOGY

A complete identification and description of the ground water system underlying prototype Tracts U-a and U-b will be the major objective of this investigation. Most of the information on the existing ground water aquifers is not available since no groundwater investigations have been made in the immediate region of the two tracts.

A site specific ground water investigation is required to satisfy numerous questions which involve potential problem areas such as:

- °Leachates which could result from surface water percolating through spent shale piles
- °Wastewater disposal to septic tank drain fields or oxidation ponds
- °Effect of mining operations on ground water quality and movement
- °Quantities of ground water available for the oil shale development

The ground water hydrology study is important to both environmental and mining considerations. Large quantities of ground water may have to be pumped from the vicinity of the underground mining zone prior to and during mining operations. If this is necessary, responsible handling of this water will be required. The effect of ground water removal on surface water and upon communicating aquifers, if any, must be determined. Information pertaining to both quantity and quality of underground water as well as transmissivity and flow rates must be developed to evaluate the magnitude of these potential impacts and to determine what mitigation steps may be necessary or desirable.

Based upon a review of published and unpublished data, a program to collect baseline hydrologic data has been formulated. The program is tentative and it may be subject to revision during implementation as data become available during the course of geological exploration and as the subsurface ground water regime is defined by pump tests. The program is designed to provide information on existing ground water conditions including:

- °Water-table elevations.
- °Piezometric surface elevations.
- °Radius of influence of pumping holes with time.
- °Water quality.
- °Physical characteristics of aquifers.

The necessary field investigations will be performed to fully describe the area's ground water resources, including test hole drilling, pump tests, geophysical logging and water quality sampling. Information gathered and documented will include a description of the region's groundwater system.

Test wells will be drilled early in the exploration program to identify the existing ground water aquifers that lie above the base of the Green River Formation. To adequately describe the subsurface geology of the area, it is expected that a number of test wells both on and off the site will be drilled. Observation wells will then be placed at suitable locations along the periphery of the two tracts and within the interior of each tract to monitor ground water level fluctuations and water quality.

It will be necessary to drill separate observation wells for each water bearing zone and isolate the horizon to insure that unique ground water data is collected for each aquifer. A limited number of pump tests will be taken for each aquifer above the base of the Green River Formation. Each pump test will require the installation of two or three observation wells to measure the drawdown from the pumping well. Three observation wells will be drilled at each potential spent shale disposal site as soon as possible to enable the full two-year baseline monitoring program to be implemented in October, 1974. In addition to the program outlined above, an evaluation of off-tract ground water will be undertaken in recognition of the fact that these prototype tracts are not hydrologically autonomous and as such must be studied on a larger regional scale.

At six-month intervals, water level measures, temperature and comprehensive water quality samples will be taken at all observation wells on the lease tracts and at other oil shale development properties adjacent to the two tracts.

Groundwater quality parameters recommended for monitoring are identical to those included under trace elements and inorganic chemicals for surface water quality monitoring. Sample collection scheduling will be performed as directed in the Federal Register.

Once a month or more
for 6 mo to establish
trend then once
every 6 months

No hole locations
Sub plan with
core holes
?

B. AIR RESOURCES

A comprehensive two-year atmospheric monitoring program, which in all respects exceeds the requirements stated in section 1(c)(2), paragraph (c) of the Oil Shale Lease Environmental Stipulations, will provide data on meteorological factors and air pollution levels in order to define current baseline air quality against which future trends can be compared, and to determine the capability of the atmosphere in the tract areas for dispersing any pollutants which may be generated there in the future. This information will then be utilized, with appropriate modeling techniques, to assess the expected air quality impact of plant operations and to assist in the selection of the optimum plant site location in compliance with the National Environmental Policy Act of 1969.

The overall air resources impact assessment approach divides into five phases, the first of which begins concurrently with approval of this plan:

Phase 1 - Acquisition, calibration, and installation of monitoring equipment and field facilities.

Phase 2 - Two-year baseline data acquisition program and supplementary experiments.

Phase 3 - Establishment of air quality related plant siting criteria and selection of plant site.

Phase 4 - Assessment of air quality impact of the development and operation of the plant and of its compliance with applicable air quality standards, and consideration of mitigating measures.

Phase 5 - Continuous air quality monitoring during plant construction and subsequent operation.

Phase 1 is followed by Phase 2, while Phases 3 and 4 take place during the course of and immediately subsequent to Phase 2. Phase 5 would begin after approval of the development plan and completion of Phase 2.

The tools to be used in this work include a comprehensive array of state-of-the-art analyzers, sensors, and analysis techniques, combined with a number of classical approaches and, in cases where the uniqueness of the situation warrants it, some very recently developed (but properly validated) equipment and analytical tools. Equipment and analysis are used as required to meet the needs defined earlier, with the lease stipulations serving only as a guideline for the minimum amount of equipment required.

1. AIR QUALITY

Tracts U-a and U-b currently contain few anthropogenic sources of air contaminants, with the major one being Utah highway 45 which passes through tract U-b, nor are there any significant sources in the near proximity of the tracts. The only nearby development of any consequence is the small town of Bonanza, some 4 miles north of the nearer of the two tracts (U-b); more significant developments exist in the vicinity of Vernal (about 40 miles NNW) and Grand Junction (about 65 miles SSW). Thus air quality in the lease areas is presently governed almost exclusively by the conditions of air masses which have been transported into the area over long distances of essentially source-free countryside, with little contribution from local sources, and is therefore fairly uniform throughout the two tracts. Future tract development and subsequent mining and processing, along with related activities, will thus become the only significant sources of air pollution in this area.

These considerations influence the approach taken by the lease operators toward air quality monitoring during the baseline data acquisition period and during subsequent plant development and operation, and affect the analysis of plant impact.

a. Methodology

The approach to the collection of baseline air quality data involves, first, a network of fixed air quality monitoring stations within the two tracts and in nearby locations. These stations will monitor air quality continuously for the entire two years of the baseline study period, thereby providing detailed data on conditions in the lease areas, in areas upwind of them in which the local background levels are defined, and in downwind locations which are likely to be receptors of whatever air pollution will subsequently be generated within the tracts.

Second, a number of special experiments will be performed during the two-year period -- some regularly, some only once -- to better define current conditions with regard to visibility, suspended particulate size distribution, soiling, carcinogens in the air. These are all factors of concern for the health and welfare of individuals residing in the vicinity of the tracts, and their baseline levels should be assessed. Also, the current impacts of local sources such as the town of Bonanza and of highway 45, will be measured.

A total of eight sites will be instrumented for the continuous monitoring of sulfur dioxide (SO_2), hydrogen sulfide (H_2S), and suspended particulates (SP). Four of these eight will also monitor reactive hydrocarbons (HC, defined as total hydrocarbons less methane), nitrogen dioxide (NO_2), carbon monoxide (CO), and ozone (O_3). Federal Air Quality Standards currently exist for all of these pollutants except for H_2S. The monitoring instruments to be used (which are described in detail in the following section), also measure total hydrocarbons (THC), methane (CH_4), nitric oxide (NO), and total oxides of nitrogen (NO_x), all of which are of interest for certain special purposes and will thus be recorded.

All of these pollutants will be measured continuously (i. e., once every 10 minutes or more frequently) except for suspended particulates, which will be measured by taking a 24-hour sample once every 6 days. This is considered adequate by the EPA for satisfying the monitoring requirements of the suspended particulate air quality standard.

Since significant variation in pollutant concentrations is not expected from station to station because of the absence of local sources, extremely detailed monitoring is not warranted for those pollutants which are not expected to be generated by the oil shale operations. Thus only four stations are proposed for the monitoring of the photochemical reactants HC and NO_x and for their product O_3, as well as for CO. These stations will provide quite adequate resolution of the spatial variability of these pollutants.

The exact locations of these eight stations are yet to be defined. Two of the complete units will be coincident with the two major meteorological stations which will be in proximity to two probable plant site locations. The other six will be sited so as to completely cover the lease area and likely receptor regions nearby.

Air Monit
Locat
b pla
?

After the first year of monitoring is completed, the site locations will be reviewed. If, on the basis of the data so far obtained, it is concluded that one or more stations are providing redundant data, or that more significant information could be obtained at a different locations, then those stations will be relocated. Similarly, if the proposed plant locations in the development plan differ from either of those locations near which monitoring was provided, then the appropriate air quality and meteorological station(s) will be moved to the new plant site area.

A mobile air quality station, containing equipment identical to that in the four full stations, will be used to supplement the eight fixed stations and to assist in defining any changes in station location which might be needed after the first year. This station will be used to explore in detail the air quality around current source areas, such as around the town of Bonanza and along highway 45.

Visibility in the oil shale lease area is currently very good and any degradation of this aesthetic factor would be of reasonable public concern. To obtain baseline information on visibility, an integrating nephelometer will be installed at one of the air monitoring stations. This instrument will continously monitor the light scattering properties of the atmosphere, which can be directly related to the visibility in a well-defined quantitative manner. Periodic photography of distant vistas will provide an easily interpretable reference for the continuous point measurements made by the integrating nephelometer.

The size distribution of ambient particulates is important, since only particles in a narrow size range can affect the human respiratory system, while much larger particles can dominate the mass collected by the high-volume sampler. Coincidentally the particulate size range which most affects visibility is also that which most remains in the respiratory system, thus the integrating nephelometer provides information in this regard also. The AISI tape sampler with readout in "coefficient of haze" units is also more sensitive to particles in the respirable size range than the high-volume sampler, and thus one such instrument will also be installed and operated continuously at the same point as the integrating nephelometer. This EPA approved device (for which, interestingly, no corresponding Federal Ambient Air Quality Standard exists) provides hourly data continuously, and its measurements are also an indicator of the soiling effects of air pollution, an important aesthetic factor.

Size fractionation of suspended particulates will be performed on occasion during the period of the study, in order to better quantify the measurements of the integrating nephelometer and the AISI tape sampler. Because of the expected low particulate mass concentrations, sampling over 24 hours or more will probably be necessary in order to obtain sufficient mass in some of the size ranges.

Elemental analysis of the material collected on the high volume filters will be carried out periodically to determine the current concentrations in the ambient air of such trace elements as lead and beryllium, for which health effects exist. Vehicular operation in the lease area can be a source of atmospheric lead in the future.

Filter samples will also be analyzed periodically for polynuclear aromatic compounds. Because of recent concern about possible carcinogenic emissions associated with oil shale processing, such analyses will establish current levels of this type of organic matter.

Two instrument technicians, experienced in the operation and maintenance of equipment in the field, will reside on or near the lease area at all times during the baseline study. They will regularly inspect and service all sampling and data collection equipment in accordance with an established written procedure, and will perform regularly scheduled extra tasks including high volume sampler filter changing, photography for visibility evaluation, collection and special handling of filters for trace metals and polynuclear aromatic compound analyses, and collection of size fractionated suspended particulate samples. These technicians will be provided with a four-wheel drive vehicle to enable them to perform their duties in snow and rain, with only rare occurrences of extremely inclement weather (during which air quality would be very good, anyway) presenting a bar to regular servicing.

b. Equipment

The choice of equipment for the baseline study is crucial -- the ~~air quality~~ monitors must meet EPA requirements and all equipment must operate reliably enough to give correct data at least 90% of the time.

Why

Check with EPA

Each of the eight continuous air quality monitoring stations will consist of an instrumented dual-axle house trailer specifically designed and constructed by the lease operators for the particular demands of the baseline data acquisition program. Each trailer will be equipped with heating and air conditioning equipment to maintain the instruments at normal operating temperatures during all seasons of the year (the expected range in ambient temperatures being from -20°F to above 100°F) and will be parked in a fenced enclosure to reduce vandalism.

[illegible] 's can up at [illegible] Vanne! [illegible]

Primary power for each trailer will be commercial 115 VAC power as much as possible. In areas where it is not practical to run power lines, propane-powered motor generators will be used. Such generators will be installed at least 100' from the instrument trailers, in a generally downwind direction from the sensors. Tests will be performed to define errors in readings if the motor exhaust should be carried past the sampling tube; experience indicates these errors are not large and are easily detected if the wind direction is known.

Each trailer will also contain an internal motor generator which will automatically start in the event of failure of the primary power source. Internal installation will insure reliability even after long dormancy or in severe weather; the proximity of the exhaust to the samplers will have to be considered, however. Automatic switches will also restart instruments, such as the gas chromatographs, which go into a "reset" mode upon a momentary interruption of electric power, such as during a change in power source. Other instruments, such as clocks, will have a standby battery power source to maintain accuracy during power outages or switching.

The air quality analyzer complement within each trailer will be identical. Each of the four full stations will contain:

1 automatic gas chromatograph with methanator, for analysis for CO, THC, CH_4 (and thus HC);
1 chemiluminescent (ethylene) analyzer for O_3;
1 chemiluminescent (ozone) analyzer for NO and NO_x (and thus NO_2);
1 automatic gas chromatograph for SO_2, H_2S, and total sulfur.

In addition, one high-volume sampler with constant flow controller and clock timer will be located on the roof of each station. Each of these analyzers or samplers operates by means of the EPA reference method for analysis of a given pollutant, or meets the EPA standards for a method equivalent to the reference method. The partial stations will contain only the H_2S, SO_2 chromatograph and the high-volume sampler.

All of the gas samplers will be taken through an insect-screened downward-facing sampling orifice above the trailer and some 14 feet above the ground level. A high flow rate glass sampling line will carry the samples into the trailer where manifolds will permit connections to the inlets of the analyzers. Excess samples not used for analysis, as well as residual byproducts of the analyses will be vented at a location as remote as possible from the main inlet. Smoking in the area of the trailer will be prohibited, as will vehicle operation (except when necessary to carry heavy equipment to the trailer).

Redundant recording of data will be provided to help assure the required 90% data reliability. The primary recording system will be a digital data acquisition system with punched paper tape output. This system will sample all analyzers at 6-minute intervals. A crystal-controlled clock will provide the time of each sampling, and is provided with a battery backup so that, should electric power be lost and then restored, the correct time of sample acquisition will always be recorded. A multipoint printing recorder will also record all channels as a backup in case of data acquisition system failure.

One of the trailers will contain, in addition to the normal instruments, an integrating nephelometer and an AISI paper tape sampler. Other equipment available for accasional use will include a high-volume cascade impactor for particulate size distribution measurement and two cameras (one with color film, the other with black-and-white film) for visibility recording.

In addition to the eight trailers, a ninth system identical to the four full stations will be installed in a 4-wheel drive truck. This unit will be used for special studies as described earlier, can serve as a standby system during breakdown or shutdown of one of the fixed stations, and can be cannibalized for analyzers or parts to quickly restore a malfunctioning station to operation.

Calibration of all of the analyzers will be referenced to EPA calibration standards, either by actual calibration of span gases or analyzers by EPA or through independent laboratory calibration under EPA observation. Analyzer calibration equipment will be maintained on site where practicable to permit periodic checks of instrument calibration and to allow recalibration of any analyzer which has required servicing which could have affected its calibration. Calibration of recorders and the digital acquisition system will be carried out against appropriate NBS traceable voltage standards.

The frequency of calibration will vary with the type of instrument, ranging from once per 24 hours to once per 3 months. Guidelines presented in the EPA document series, "Guidelines for Development of a Quality Assurance Program" will be followed, and calibrations will be more frequent initially until a drift history for each instrument has been established.

Each station will be able to operate unattended for at least two weeks, except for the high-volume sampler which requires a filter change once every 6 days. Thus, although servicing at 3-day intervals (with greater frequency initially) is envisaged, data acquisition would continue even though unusually severe weather might prevent regular maintenance for a short period. Standard high-volume sampling schedules allow "make-up" days, so that a sampling day missed for such reasons would not impact the 90% reliability limit.

After the baseline study is completed, the same instrumentation will be used on-site for the air quality monitoring required during plant development and operation.

c. Analysis

The air quality data obtained during the baseline study will be mainly in the form of punched paper tape with backup strip chart recordings. In order to insure that all data is not lost by accident, both of these records will not be shipped from the site at the same time.. Other data will be in the form of undeveloped film, and as particulate samples on filters or on impactor collection media. Because of the absence of redundancy in these, they will only be transported by a courier.

Initial processing of the paper tapes will be by computer for the purpose of tabulation of hourly averages of all gas concentrations, and comparison with all relevant ambient air quality standards. Categorization of data in terms of meteorological regimes will also be carried out.

The high-volume filters will be weighed by an analytical laboratory to determine particulate mass. (The blank filters will have been weighed before use, also.) Periodically, some filters will be analyzed for lead (by atomic absorption analysis) and for other trace metals (by neutron activation analysis or other appropriate techniques). Some filters, specially handled to prevent oxidation of the sample, will be chemically analyzed for polynuclear aromatics.

The ultimate use of the data thus acquired will be two-fold. First, it will provide a detailed record of the current air quality situation in the lease area. Second, it will provide a base (along with the meteorological data) for assessment of future plant impact.

For the baseline application all the air quality data will be categorized by meteorological regimes, related to air quality standards, and probable source areas identified. The significance of the special measurements of visibility, particle size distribution, soiling, trace metals, and polynuclear aromatics will be assessed and related to the same source and meteorological considerations. Areas of doubt will be resolved and, where feasible, extra experimentation will be performed to resolve any significant uncertainties in the interpretation of the data.

For forecasting and impact assessment, the current data serves as a reference base from which modeling can begin. Adjustment of background values due to sources external to the tracts will have to be made, considering expected growth and changes in their emissions. Some of these, e.g., Bonanza, are likely to be strongly influenced by plant development and operation. The emissions from others, such as Vernal, are more likely to be independent of the plant.

Because of the complexity of the terrain in the lease tracts area, computer modeling of air pollutant transport and diffusion is expected to be quite difficult. The various factors affecting dispersion, including air flow streamlines and turbulence levels will have to be defined in considerable detail. These, in turn, are governed by the synoptic meteorological situation, by solar heating, and by topography. Details of the methods used to acquire and process this information on the dispersive properties of the atmosphere is presented below in the discussion on meteorology. Once they are defined with adequate resolution, the modeling of air quality impact will proceed.

A variety of developed computer models, tailored for the specific conditions at the site, will be used. Standard plume rise formulas, coupled with developed rational plume dispersion models will be used for effluent emissions from stacks. Diffusion of lower height emissions, such as fugitive dust and emissions from motorized equipment and vehicles, will be handled by appropriate point or area source models in which the effects of surface roughness are entered. The photochemical reactions occurring in parcels of air containing emissions from the plant will also be modeled, although photochemistry is unlikely to be a problem in this area.

All of these modeling approaches will be exercised for a variety of meteorological conditions, with particular emphasis on stagnant condition in valleys and with consideration of the complexities introduced by drainage flows in the complex topography there. A number of likely plant sites will be considered to assess the significance of alternative locations and to assist in selection of the final plant location.

2. METEOROLOGY

The complex terrain in the lease area has a significant influence on those meteorological factors related to air pollution dispersion. The topography varies in elevation from 4800' above sea level at the White River to 5900' just S of the tracts, is mostly between 5200' and 5600', and has many gentle hills and a few very sharp ravines. Significantly higher terrain is about 40 miles away.

The region has little precipitation -- about 9" per year, with peaks in June and October. Both summer and winter can be expected often to have very light winds, and fogs are common in winter. Below about 5600' one can anticipate nocturnal inversions winter and summer, which inhibit effluent dispersion. The complex topography will result in complex nocturnal drainage flows below this height. Except for the very light wind cases, the terrain roughness can be expected to yield moderate or strong turbulence and hence moderate or strong effluent despersion. The height of effluent release (or rather, effective stack height) will have a large effect on surface concentrations of pollutants from local sources.

The details of the mesoscale/microscale mean flows and turbulence for such terrain are not established with acceptable certainty. Also, climatological data for the specific area do not exist, although six hourly winds are available from Green River and Roosevelt. The nearest radiosonde station is at Grand Junction, but because of topographic influences the winds below about 8000' above sea level cannot be related closely to the Grand Junction winds. The next nearest radiosonde at Salt Lake City is of minimal use here because of its remotness.

a. Methodology

The approach to the measurement of meteorology is philosophically similar to that of the air quality measurements, with some continuous monitoring of meteorological factors for the entire 2-year period, supplemented by special measurements and experiments designed to answer certain crucial questions concerning air flow and turbulence in the lease area.

Continuous measurements will be made by two instrumented 100 ft. towers, located at two probable plant sites, and sharing the data facilities in the air quality trailers there. Instrumentation on these towers will monitor wind speed and direction at ground level, 30 feet, and 100 feet. Temperature will be measured at 30 feet and at 100 feet. The lease requires that humidity also be measured at ground level, 30 feet, and 100 feet. Since there is no clear reason for this redundancy, permission to use only one humidity sensor on each tower, at 30 feet above the ground, is requested. These measurements will give indications of low level wind shear and of surface-based atmospheric stability.

Ch propo[illegible] to monitor [illegible] of [illegible] [illegible] EPA Oa [illegible]

To further define details of the low level airflow, an anemometer on a 30 foot mast will be installed at each of the other six air quality station sites to record wind speed and direction. In addition, several mechanical weather stations will be sited at key areas remote from the permanent sites to give wind and temperature to help describe flow features.

Turbulence is a key factor in the analysis of dispersion, thus its measurement by anemometer is planned at the tops of the two 100' towers and at the highest altitude permanent station. Because of the effects of temperature on drainage flows, this highest station will also monitor temperature.

Continuous monitoring of dispersive characteristics at greater heights above the ground, particularly well above the mountain tops, is also needed. Construction of a tower high enough for this purpose is not practical, thus the use of acoustic echo sounding equipment is envisaged. Such instrumentation provides a continuous record of atmospheric structure up to 3000 feet above its antenna. In conjunction with the Grand Junction radiosonde data it will provide necessary information on upper air conditions above the lease tracts.

These routine meteorology and air quality observations are an expanded version of those needed for meeting regulations and describing baseline air quality. They are not totally adequate, however, for determining the manner in which the atmosphere will disperse any pollutants caused directly or indirectly by the shale oil operation. For making such dispersion predictions, and hence impact predictions, predictive models based on appropriate observations must be used. Such models are sufficiently developed so that they can be used if turbulence and mean flow fields can first be ascertained.

The mean flow and turbulence fields of importance include the region well above where the fixed measurement system operates -- up to 2 km above the ground. To some extent the characteristics of this region can be estimated with adequate accuracy from the fixed station system and the soundings and upper air maps available from the National Weather Service, but some supplementary measurements are necessary.

During two periods within the first study year, special field studies of about two weeks duration each will be performed to study atmospheric dispersion in the tracts in detail. These tests will consist of smoke or oil fog releases from balloons at various heights above the ground, at dawn to illuminate drainage flows and in early afternoon to show valley wind effects. Photography and probing (where safe) by an aircraft equipped with an integrating nephelometer will define plume dispersion. Pibal launches and aircraft soundings three times a day will give details of wind, temperature, and turbulence up to 6000 ft above ground level.

The meteorological program will dovetail with the air quality measurements, and will share the same field personnel and data equipment. These aspects of operation have already been described earlier and thus will not be repeated here.

b. Equipment

The equipment selected for the meteorology study must meet even greater reliability requirements (95%) than the air quality instruments. Fortunately, meteorological sensors are inherently rugged and reliable, and the more likely areas of non-reliability are electrical power and recording. Since redundancy has been provided in all of the power and recording systems in the trailers within which both the air quality analyzers and meteorological system electronics are situated, the 95% reliability factor should not present a problem.

On the 100' and 30' towers, the anemometers will be of the cup and vane type, with threshold below 1 mph, response distance less than 5 ft, and proper (0.4 to 0.6) damping ratio. These characteristics make them suitable for turbulence measurement also, and three of them will be equipped with sigma meters to compute the root mean-square lateral dispersion. The temperature sensors on the towers, of the thermistor type, will be housed in proper radiation shields. The humidity measurements will be continuously made by electronic measurement of either dew point or relative humidity. Recording of all these parameters will be continuous on the multipoint recorders, and running means will be processed for recording on the digital data system.

The mechanical weather stations will be of a well proven type with a wind vane, cup, and a bimetallic temperature sensor. Recording is on pressure sensitive paper by a stylus, with the chart drive driven mechanically with a battery driven winding mechanism.

The meteorological sensors require calibration and maintenance less frequently than the air pollution analyzers, and they are also less easily accessible. Calibration of the anemometers before the study and once per year thereafter should suffice, while quarterly calibration of the humidity and temperature sensors is adequate. Calibration will be performed by appropriate testing laboratories. Operation of each unit will be checked at the same time that adjacent air quality analyzers are checked. The mechanical weather stations require service only once per month, but weekly checks will be made if possible.

The acoustic sounder requires infrequent service, except for occasional operational checks, and no calibration is required. Being situated in one of the trailers, it will receive frequent observation.

During the special field studies turbulence will be measured from the aircraft by means of an inertial subrange turbulence measurement system, which measures turbulence independent of aircraft speed. Temperature will be measured by a thermistor probe, and both parameters will be recorded on board the aircraft on a strip chart recorder. Pibal tracking, by double theodolite, will also be performed.

All meteorological instrument exposures will meet NOAA, WMO (World Meteorological Organization), and EPA criteria whenever such criteria are relevant. In a few cases where low-level flows are of interest, deviation from these criteria will be justified.

c. Analysis

Processing of meteorological data will follow the same procedures as described before for the air quality data. Meteorological regimes will be defined and the data will be classified on the basis of these regimes to determine frequency of occurrence. These regimes will be correlated with radiosonde-derived climatological statistics at the nearest National Weather Service stations. In this manner the studies for the tracts can be assembled into statistical presentations based on long-term records, and the chance of the possibility that measurements during the two years were not representative of long-term trends can be assessed.

The meteorological data will be analyzed to provide (1) assessments of the terrain induced flows and turbulence, (2) statistics on stability categories and winds aloft, and (3) statistics on probable adverse air pollution conditions (low winds, strong stability).

For inputs to the air pollution diffusion modeling, a set of flow categories will be developed, related to the regimes just mentioned. The flow categories will include seasonal and diurnal variations, and will be related to winds aloft, and to stability aloft (which identifies the connecting link to flows aloft). The field observations, expecially the complete ones during the flow/diffusion test periods, will put the modeling on a sound footing.

C. BIOLOGICAL RESOURCES

Since the wildlife components of the region are dependent upon the existing vegetation, the ecosystem approach will be employed in all data collection and analysis. This approach attempts to view the biology of any region as an integrated, interdependent, dynamic system, rather than in a fragmented manner. The effect on one component of the ecosystem will affect the other components to a greater or lesser extent.

Prior to any biological field studies, collection and trapping permits will be obtained from permitting agencies. Biological societies and organizations (e.g., Audubon Society, National Wildlife Federation, American Fisheries Society, etc.), as well as appropriate federal and state agencies, will be notified of the conduct of the study in order to coordinate the exchange of collection data and biological information.

1. VEGETATION

A comprehensive study of the flora is essential to any understanding of the environment of the oil shale lease tracts and adjacent lands. For data collection purposes, the vegetation will be divided into three strata: trees, shrubs, and herbs. Trees are defined as woody species with a diameter at breast height (DBH) greater than five centimeters. Shrubs are defined as woody species with a DBH of five centimeters or less. Herbs would include grasses, sedges, forbs, and cryptogams (lichens and mosses).

Once complete species lists have been compiled and the community types determined, detailed vegetation mapping will begin. The extent of the vegetation units will be plotted onto topographic maps based on the field walks and drive-throughs. Aerial photography, including color and false color infrared, will also be employed in this mapping process. The existence of any unique or rare plant populations or ones which possess recreational or economic value will be determined during this phase of the project.

Community structure analysis is dependent upon completion of the mapping phase of the study. Accurate analysis requires an understanding of the degree to which the area is homogeneous. In areas where the vegetation is highly homogeneous, fewer numbers of samples will be required. The opposite is true of discontinuous areas.

Permanent plots will be established in each of the vegetation types. However, a number of random samples will be taken for comparison purposes and later will provide important information for the ecosystem analysis. The point quarter method will be employed for the tree strata. Line interception and Daubenmise frames will be used for the shrubs and the herbs. These measurements will provide the data necessary to establish density, dominance and frequency characteristics for the species. Estimates of primary productivity will also be made at the location of the permanent plots. This will involve clipping samples of the herb vegetation which will be saved for lab analysis. From this data, gross differences in the primary productivity of the major vegetation types can be determined.

The information gathered during the reconnaissance, mapping and sampling phases of the biological inventory will not only provide the data necessary to characterize the existing ecosystems but will also be essential to any discussions concerning mitigation measures. The data will be stored in tabular form and, if deemed necessary at a later date, on computer cards to facilitate easy reference and retrieval.

2. WILDLIFE

Baseline environmental studies will be conducted at bi-monthly intervals as required by the lease stipulations. If indicated, additional data gathering trips will be conducted on the site. The specific bi-monthly intervals will be altered in those instances where it is felt that more significant data would be gained by the change. Specific cases would involve peak periods for deer on the winter range and peak periods for fawning. Peak periods for golden eagles and other migrant raptors will also affect the timing. Optimum periods for gathering data on other migrant species will affect the timing, also.

As the study progresses, any modifications that are felt necessary to improve the quality of data gathering or the findings will be investigated.

Studies will be conducted not only on the tracts, but also in the surrounding areas. Distance away from the tracts with certain limitations will be determined by the species being studied and their movements. In some cases distances of five (5) or more miles are well within reason. This is especially true in the case of some raptors which range over large segments of land in their normal foraging activities.

Activities between all data collection teams, including those from federal and state agencies and universities, will be coordinated to obtain the greatest amount of useful data from on-site studies.

Specific cases would include but not be limited to the following:

1) aerial censusing of deer, elk and other large mammals that would include observations of eagles and other large raptors
2) night observations of deer and other nocturnal mammals and birds that would include observations of amphibians and reptiles
3) observations of birds, mammals, amphibians and reptiles being made by teams doing aquatic studies.

a. Terrestrial Invertebrates

The study of terrestrial invertebrates must be an integral aspect of an environmental monitoring system because of their interaction with the other biotic communities. Insects are particularly important because of their effect on vegetation (pollination, defoliation), their importance in predator-prey relationships with birds and reptiles and the importance of certain taxa as indicators of environmental conditions.

Terrestrial invertebrates will be sampled and studied by traditional methods. Collection methods will include the opportunistic use of nets, aspirators, baits and traps. Nocturnal species will be collected through the use of light traps and ultra-violet light reflected off white sheets.

Litter and earth will be placed in Berlese funnels to collect subsurface and litter dwelling invertebrates.

Stations will be strategically located in different habitats, on and around the site to sample the species-habitat diversity. Station descriptions will include precise location and vegetation type. Collections will be labeled with date and location of capture. Collected specimens will be identified and catalogued; population characteristics of density and diversity will be established. Final details of the collection and study system will be established subsequent to consultation with representatives of the United States Department of Agriculture, and other interested agencies.

b. Amphibians and Reptiles

Available literature on probable local amphibians and reptiles will be researched for what is known of their feeding and reproductive behavior, migrations, and specific habitat requirements throughout their life cycle.

A standardized procedure for collecting amphibians is lacking. There are optimal conditions and methods, however, which maximize the number of organisms collected per man hour of effort expended.

Amphibians require water for successful breeding and can be found in greater number during or after a spring rain at night. Migrants such as the tiger salamander (Ambystoma tigrinum) that have overwintered in rodent burrows will be moving to quiet water to breed, usually from March to June. When all of the aforementioned conditions are present, a vehicle will be driven slowly along State Highway 45 from Watson to within 1/2 mile of Bonanza and on other roads on and around the project area. An observer will be watching for small objects on the road. Many of these will be migrating salamanders, frogs and toads. They will be captured, identified, tagged by toe clipping, recorded on an area map according to odometer check and released. Springs, seeps and quiet pools will be sampled periodically during the spring months for egg clusters, larvae and ripe adults by trained observers with hand nets and waders.

The non-migrating Great Basin Spadefoot Toad (Scaphiopus intermountanus) may occur in the area. This toad appears soon after summer rains to breed, feed and reburrow. While on the surface, their chorusing makes them easy to locate.

The reptiles are going to be most active during the summer months when temperatures are higher. The lizards, active by day, can be approached and captured with a telescoping pole fitted with a slip-knotted noose on the end. The noose is slipped over the lizard's head and a quick yank usually results in a catch. The lizards will be catalogued and tagged in the same manner as the amphibians. Snakes will be active day or night when the temperature is above 65° F. During the day snakes may be seen on the site or found under rocks. Crowbars, heavy leather gloves and high-topped boots will minimize the rattlesnake hazard. All rocks will be returned to their origiinal positions to minimize habitat disturbances. Snakes often are found on asphalt roads at night, because asphalt absorbs more heat during the day than bare ground and a snake, dependent upon an external source of heat to maintain activity, may remain active longer into the night. This allows the snake to exploit the nocturnal mammal populations for food. Summer road running for snakes will be conducted in essentially the same manner as for amphibians. A snake stick will minimize the rattlesnake hazard. All non-venomous snakes will be catalogued and tagged by cutting small wedges of skin from the ventral scutes and recording scute number, counted forward from the anal scale. They will then be released. It should be noted that snakes are relatively rare in any habitat, and lack of sightings does not preclude their occurrence.

Analysis of Data

Habitat preference, species population and distribution projections will be determined from the raw data and frequency of recapture as determined by the tagging system.

Stomach content analyses of common species will delineate their food preferences. These analyses will require the identification of plant seeds, insect parts and the bones of birds, mammals and reptiles. Only the minimum number of animals will be sacrificed to obtain representative diets. Much of this information is available from existing available literature.

Threatened Wildlife

There are no known threatened amphibians or reptiles occurring in the project area

c. Birds

Several techniques will be used to study all species that may be found on the tracts and surrounding areas. This will include both resident and migrant species.

Random walk-throughs on the tracts and surrounding areas will be conducted initially. Most species, possible population densities and major key use areas will be determined. From these initial studies, permanent transects will be established through the various vegetative and terrain types. Larger species will be identified and population densities estimated. Total distribution and activities (both seasonal and annual) will be established through sight observations. With approval from appropriate agencies, representative numbers of some species will be trapped, banded and released for recapture to help determine movements. Smaller species will be trapped and banded for recapture using mist nets. All pertinent data for the various species will be compiled. This information will be a useful indicator in determining the effects of increased human activity on the bird populations in the area. Radio telemetry may also be used to determine the local movements of some of the key resident species. This will aid in determining the influence of human activity in the area.

With the permission of state and federal agencies, some specimens will be collected for purposes of doing crop analysis to determine feeding habits. The number of birds collected for this purpose will be kept at an absolute minimum. These same specimens will be used for parasite studies and other related research.

d. Mammals

Primary concern will be for those species which are of greatest significance to man from a recreational and aesthetic standpoint. Numbers of mule deer and possibly any antelope, elk or wild horses which may be in the area will be censused by ground and aerial counts. Observations will also be made on larger non-game and predator species during these counts, including such species as mountain lions (which are known to be in the area occasionally), coyotes; bobcats and smaller species such as fox and raccoon.

For purposes of studying deer activities and movements of migrant birds, banding operations will be conducted with approval from the State of Utah, Division of Wildlife. These will be completed during the first winter when the deer are on their winter range and most available for trapping.

Aerial censusing will be limited to those periods during the year when snow cover creates optimum conditions for counting. During these flights, attempts will be made to determine movement by observing tracks. Because of the nature of this type of observation, a helicopter will be used for these counts. During the fawning periods, walk-throughs will be made in those areas where the does are known to fawn. This will help give an indication of herd condition, breeding success and fawn survival.

Range transects will be established to determine the range condition on both deer and elk wintering areas. Records will also be maintained on the amount of browse utilization by these species. Standard techniques employed by the U. S. Forest Service will be used for establishing and running the transects. Close observations will be kept on movements as related to the amount of human activity in the area. All crews will keep observation records of species, numbers observed, location and times observed.

Small mammal populations including both game and non-game species will be studied. Larger species will be studied by standard mark and recapture techniques using live traps. Studies will also be made on walk-throughs when observations are being made on all wildlife in the area. Night observations will be made to determine movements of nocturnal species. Live trapping and marking for recapture will also be done on smaller species in the area. Standard toe clip and marking methods will be used to identify specific animals. Species identification, population densities, preferred habitat and seasonal movements will all be monitored. The use of snap traps for collecting purposes will be avoided.

To reduce needless waste of animals, all efforts will be made to research existing literature for information on food habits, habitat preference, etc. Once species are identified and the associated habitat delineated these works will show normal food habits. This will reduce the need for collection of specimens for stomach analysis.

Extensive effort will be made to detect the presence of any rare or endangered species which may exist in or about the area. This would be especially true of the black-footed ferret (Mustela negritus) which could possibly be found in association with any prairie dog towns that may be located on or near the sites.

Bat populations in the areas will be studied by capture, branding with paint and recapture techniques. Mist nets will be used for this purpose. Caves and other places where bats may rest during the day will also be searched.

3. AQUATIC ECOLOGY

Aquatic studies will concentrate on defining the kinds of aquatic habitats that will be affected by development on and surrounding the tract areas. The systems will be defined in terms of species composition, their productivity, importance to man and the relative uniqueness of habitats and species.

Studies will include continuing literature surveys and interviews with interested agencies and individuals as well as the collection and analysis of field data. Recognized experts in the various involved fields will be consulted for confirmation of organism identification and suggestions on refinement of the investigative system.

The White River forms the major aquatic ecosystem in the area. Since it only touches small section of the tracts, much of the study will be done off-site. On-site streams are intermittent and will require monitoring during major runoff periods.

a. Sampling Station Locations

Sub plan 7

The general locations of aquatic sampling stations will be determined so as to provide data from comparable habitats and communities which might be directly affected, indirectly affected, and unaffected by development on the lease areas. A minimum of four (4) stations will be established in locations upstream, on-site and downstream of each tract. Some of the stations may serve dual purposes, i.e. as an on-site station for Tract U-a and as a downstream site for Tract U-b. Selection criteria for specific station locations will include consideration of drainage patterns, disposal site location, habitat type and accessability. Physical and chemical characteristics of the stream affect organisms; biological reactions in turn affect chemical characteristics. The full interpretation of both biological and chemical findings requires consideration of these interactions. Accordingly, biological samples will be collected at or near the surface water quality monitoring stations.

b. Methodology

Specific research in the inventory program will involve the following areas:

(1) Habitat types will be surveyed to provide a basis for measuring changes due to water flow and water quality.

(2) The presence and abundance of aquatic macrophyte communities will be determined. Random transects will be established as appropriate to determine species composition and density of the community. Insect and crustacean communities become established on aquatic macrophytes. Such animals will be identified and recorded to establish population density and diversity.

(3) Plankton is not expected to be an important part of this eco-system; however, the abundance and species composition of the community will be measured at prescribed locations. Quantitative and qualitative samples will be collected and analyzed.

(4) Many species of filamentous algae grow on submerged portions of aquatic plants, rocks or artificial substrate. The abundance and species composition of this sessile community will be assessed by scraping a known

area of rock or by following growth on artificial substrates. Because these organisms stay in one location, they are more important in lotic (running water) systems than plankton and may show a clinal change over a distance from a discharge point. The biomass per unit area, an index to their importance as a primary producer in the systems, will be determined.

(5) Benthic organisms live on or in the bottom material of aquatic systems. This community consists of protozoans, worms, insects, crustaceans and mullusks. Benthos may be the main source of energy transfer from plants to higher animals. Data will be collectet to determine population composition and numbers.

(6) Field studies of fish, the highest level carnivore in an aquatic habitat, will determine species composition, relative importance of each species to its community, identification of species which are likely to be the most sensitive to changes in physical or chemical conditions of their environment, productivity of the community, existence of rare or endangered species and species of economic, aesthetic or recreational value to man.

c. Analysis

The following analyses will be directed toward identifying organisms, quantifying population characteristics, species diversity and population trends. During early stages of the study, investigative procedures may be modified as required by condition of the concerned eco-systems.

Plankton

Quantitative samples will be taken in triplicate. One complete sample will be fixed, frozen and stored in the dark. Chlorophyll will be extracted and measured spectroscopically for estimates of standing crop.

Replicate samples from the quantitative sampler will be strained through #16 bolting cloth for concentration and stored in 25 to 50 milliliters of appropriate preservative solution (Lugol's, formalin, glycerin-alcohol, etc.). Only one sample will be analyzed; one will be stored for use in case of mishap to the other. The quantity of preservative will be standardized to facilitate statistical treatment. Each sample will be coded to show date and location of collection. Species composition and population densities will be established by the following method:

(1) The sample will be shaken gently to suspend the material.

(2) A one milliliter aliquot will be withdrawn by pipette and placed in a Sedgwick-Rafter type counting cell.

(3) The sub-sample will be examined on a dissecting microscope. All organisms which can be identified

will be counted, removed with an Irwin loop, and placed in a Petri dish.

(4) Organisms which cannot be identified with a dissecting scope will be transferred to a glass slide and identified with a compound microscope.

(5) Five to ten aliquots will be examined by this method.

(6) After examination of aliquots the remaining material will be examined with a dissecting microscope to note any taxa not found during examination of the aliquots.

(7) All materials will be returned to the sample container and the container stored in the dark.

(8) Data which has been generated will be entered in permanent records by date and station location. Data will include the number of families, genera and species recorded and their number per liter of water.

Attached Communities (periphyton-aufwuchs)

Rock scrapings as well as artificial sutstrate samples will be used to collect periphyton. Styrofoam samplers will be employed at selected stations with retrievals at appropriate intervals. Organisms occupying a standard area (generally one square centimeter) will be identified and enumerated by a process similar to that used for plankton.

Macrophytes

The aquatic macrophytes will be collected qualitatively to determine species composition and relative abundance of emergent and submerged plants. Selected quandrants will be established for observation.

Benthic Macroinvertebrates

Community structure of benthic macroinvertebrates will be determined through use of Surber samplers or Ekman or Petersen dredges. Triplicate samples will be collected initially and later revised if necessary. Sampling points within each station will be chosen to represent a variety of habitat types. Samples will be analyzed and species population per square meter (or other given area) established as outlined in Limnological Methods, Paul S. Welch, 1948. Qualitative samples will be collected along the edges of pools and banks. Drift organisms will be sampled with drift nets for 12-hour periods during spring and summer months. Species diversity will be calculated.

Fishes

Seining, used in conjunction with the capture-recapture method, will serve as the basic tool for fishery evaluation. Fish will be seined on consecutive days at selected locations. Fish captured the first day will be identified to species, weighed, measured, tagged and released. Fish captured on subsequent days will be recorded. Condition factor of the fish will be established. Population size will be calculated by the use of recognized methods. Electroshocking technique and diet analysis will be conducted as approved by the State of Utah, Division of Wildlife. Particular attention will be devoted to rare or endangered species of fish. Detailed records of captures will be maintained with notes on relevant environmental data as agreed upon by the Mining Supervisor and other interested agencies or individuals.

4. ECOSYSTEM ANALYSIS

The baseline data from the various vegetation and wildlife studies will be used to compile a synthesis of the characteristics of the existing ecosystem. The information developed on plant species density, dominance and frequency will be standardized into relative amounts and incorporated into an Importance Value (IV). An IV represents the relative status of a given plant species to all other species in a given sample. When all species have been assigned an IV, the samples can be visually displayed using Coordinate Axes (ordination) and graphs (dendrographs) to show relationships between the various samples. Tendencies between environmental gradients (moisture, soil texture, substrate, etc,) and vegetation composition are easily discernable from these graphic displays. Concurrently, the successional characteristics to the landscape will be assessed. Successional processes are of considerable importance in any understanding of the variation in population dynamics and ecosystem function. Since the oil shale leases cover landscapes where rainfall is known to be marginal, succession after a disturbance will be a major concern to any revegetation plan that may be devised. Species tolerances to high salts in the soil will also be important and naturally effect succession.

Finally, the data from the various wildlife studies will be analyzed to produce an understanding of the food web and trophic relationships for the Utah ecosystems. In combination with the plant community analysis, the general ecology of the region will then be established.

D. GEOLOGY AND SOILS

1. GEOLOGIC INVESTIGATIONS

a. Surficial Reconnaissance

A geologic reconnaissance will be conducted simultaneously with the soil survey. The study will cover the regional physiography and general geology of this portion of the Uinta Basin in eastern Utah, and the specific site details pertaining to the topography, drainage, surface stratigraphy and structure, and natural geologic hazards. Acceptable sites for spent shale disposal will be identified in order to expedite the location and drilling of required ground-water observation wells described previously. Any occurrence of resources other than oil shale found during the ground-water investigations such as nahcolite, bituminous sand, or gilsonite will be recorded. Mapping will be done using color aerial photographs and topographic maps following preliminary photogeologic studies.

b. Subsurface Interpretation

Available subsurface geologic data, integrated with the surface information will be augmented by drill logs and electric logs from holes drilled for ground-water investigation during this phase of the project. Present information does not indicate that the near-surface geologic structure is sufficiently complicated to warrant high resolution reconnaissance or seismic refraction surveys.

2. SOILS SURVEY AND PRODUCTIVITY ASSESSMENT

a. Soils Survey

The soils of the tracts will be surveyed according to standard procedures outlined in the U.S. Soil Conservation Service Soil Survey Manual and appropriate Utah State Agricultural Experiment Station publications. The soil survey will utilize established terminology and techniques but will be sensitive to the nature of existing conditions in relation to the potential impacts on the soil surface and its productivity from vehicle traffic, test hole drilling and intensive development of a shale oil extractive industry in the immediate region.

Survey work will be conducted in a series of professional activities as follows:

(1) Reconnaissance of the area will be done to generally relate vegetation, topography, slope, parent material outcrops, known geologic patterns of the area and other evidence of soil differences and influences on the development of soil units of the area.

(2) Soil profile analyses to determine a number of key characteristics of soils and serve as a basis for determining productivity and potential productivity (if a difference exists). Visual observations would be performed to include the following:

  - Depth of soil mantle
  - Profile development and units

- Rooting depth
- Temperature, by depths
- Appearance, such as color, presence of stones, salts, aggregation, soil animal habitats
- Restrictive layers, if any
- Percolation rates
- Porosity - air exchange
- Collection of soil samples for chemical and physical analysis

(3) Physical measurements. Several physical aspects of the soils would be described from either field study or laboratory analysis. They include:

- Soil moisture status of various depths at key points in the year - primarily the growing season. This involves field study.
- Soil/water relationships, other textural analyses of various profile units to determine soil particle size distribution
- Soil bulk density
- Clay analysis
- Other physical measurements as appropriate in the area of soils/engineering.

(4) Chemical measurements. A careful assessment of critical soil chemical properties would be undertaken as a measure of productive capacity and potential

problems for revegetation. Some of the key analyses would be:

- Total and soluble salts
- Key fertilizer elements; N,P,K,S (total available)
- Minor elements that may cause deficiency or toxic problems in vegetation such as Mo, Zn, Bo, Na, Ca, Mg, etc.
- Organic matter
- Carbon
- pH
- Cation exchange capacity

(5) Soil mapping. On the basis of the above analyses and observations, the lease tracts and relevant adjacent areas of the soil units will be delineated on appropriate scale maps. This soils map would be correlated with vegetation types and specific plant communities present in the area. Care would be exercised to relate the soil units identified here with soils identified in existing surveys of the Ashley Valley and adjacent areas in western Colorado.

b. Productivity Assessment

Assessing productivity of the area is primarily a problem of correlating the basic productivity of plants in relation to water resources, soil and animal life. A total productivity assessment would be prepared from these inputs: plants (by season) plus animal life (by season and by habitat).

Plant productivity would be assessed from appropriate size field plots. Possibly meter square quadrants for understory plant species and 10 meter square quadrants for dominant shrubs and small trees, actual dipping or harvest of current year's growth would be taken only on off-tract sites for training of personnel to use estimation techniques. Other measures of standing biomass and animal populations would be employed as appropriate (arallel biological studies will be conducted as discussed in Section V-C-I).

Productivity assessment would be done according to well defined phenological development stages during the growing season. Sampling for productivity would follow established principles for statistical adequacy and stratification over the variability of the sites.

c. Vegetation

The major emphases in vegetation survey and monitoring are species composition (lists of species), plant distribution (mapping), phenological development (seasonal changes), and habitat ecology (site information, reproduction, establishment, etc.).

Established methodology for vegetation analysis would be followed and would consist primarily of field plots of appropriate size and distribution to achieve statistical accuracy. The same plots used to obtain a measure of species composition will be utilized to determine productivity. Because of the difficulty of identification of some species in the absence of flowering characteristics it may be necessary to extend the vegetation survey over the greater part of the growing season.

Reference plots will be established in typical areas of vegetation on the oil shale tracts. These plots will be visually inventoried and mapped using information gathered from other plots. Reference plots will be outlined with a highly visible boundary for aerial photography. Repeated photo flights will be timed with ground observations of the reference plots to produce a photographic record of actual conditions for future reference.

Ecological Observations

Key species of dominant plants will be observed for their phenology and interrelations with other plants and the animal populations in the area. Such information and other observations as needed for ecological interpretation will be obtained as part of a team effort. This baseline ecological information will serve as background data for needed studies of revegetation.

Some of the information to be obtained include:

- Soil temperature
- Plant canopy and understory relationships
- Soil nutrient distribution in relation to rooting depth.
- Reproduction time, amount
- Seed germination and growth
- Other autecological data

Reference to Previous Data

The Bureau of Land Management has extensive (not site-intensive, however) date on production, species composition and previous grazing use history that should be used to obtain a longer term of reference for vegetative productivity of the area. These records and the personal observations of technical BLM staff will be included in any assessments of the flora, fauna and ecology of the sites.

3. SEISMICITY

Tracts U-a and U-b lie in an area of low to moderate seismicity between the Sevier Orogenic Belt to the west and the "mineral belt" in Colorado to the east (zones with histories of greater seismic activity). There is some potential for local earthquakes in the site vicinity and with it a potential for some degree of damage to underground mining operation and mine facilities. Seismic behavior of the site and the local region can be monitored with seismographics and strong motor accelerometers. The recording instruments now in operation in the region may be supplemented with on-site devices which may be installed as part of the resource exploration program.

May want to include base lin
Micro seismic;
ck with BOM

E. HISTORIC, SCIENTIFIC AND AESTHETIC RESOURCES

1. ARCHAEOLOGIC SURVEY

There are recorded archaeological sites on Tract U-b and the adjacent land along the White River. A preliminary archaeological assessment of the lease area is currently being conducted under the direction of Professor J. P. Jennings, University of Utah. This preliminary assessment consists of an initial record check of all existing known sites on the tracts, followed by field spot-checking the areas of greatest potential. These areas will primarily be just above the flood plain of the White River, Evacuation Creek, and Southam Canyon. This report will highlight the areas of prime concern.

The next phase of investigation will include a detailed field survey of both tracts and areas outside the tracts that may be impacted. It is anticipated that this survey will be conducted by the Utah State Archaeologist's staff. Areas that are planned for environmental monitoring facilities, above ground process facilities, roads, and disposal sites will be considered as critical areas and will be surveyed in detail as soon as possible.

A detailed surface survey will consist of thoroughly walking over all areas believed to be critical and recording and briefly describing any artifacts or signs of human habitation. The State archaeological crew will be assisted by the lease operator's antiquities staff, who will coordinate with the environmental scientists and mining engineers in planning around known sites or in arranging for the scientific excavation of sites should they be located in an area critical to the environmental program or proposed development operations. A detailed surface survey of all of the tracts and lands outside the tracts which may be impacted by the mining operation will be completed and a report of the results submitted to the Mining Supervisor prior to the construction or installation of any mining facilities.

Archaeological sites that might require scientific excavation will be supervised by Dr. J. P. Jennings, Professor of Archaeology and Anthropology, University of Utah.

2. PALEONTOLOGIC SURVEY

Geologic formations in the region similar to those which occur on the project site have yielded several fossil locations. A detailed paleontological survey will be conducted by the lease operator's antiquities staff, the State Archaeologist and consultants from the University of Utah. This survey will be conducted at the earliest possible date and will be followed by a report submitted to the Mining Supervisor, BLM, and other interested parties. Any sites that will require scientific excavation will be excavated by the lease operator's antiquities staff, in conjunction with a public institution, after approval of the Mining Supervisor.

3. HISTORIC SITES SURVEY

A field survey of the lease areas and areas outside of the tracts that will be impacted by the mining operations will be conducted by the State Archaeologist to locate and identify any historical sites affected by the project. A detailed regional and site history report will be written by the State Historical staff and the lease operator's antiquities staff. This report will be submitted to the Mining Supervisor, together with the archaeological report previously discussed.

4. AESTHETIC VALUES

Existing aesthetic values will be considered in planning and design of all facilities required for implementation of the Partial Exploration Program. These values will be documented photographically prior to initiation of any data collection and monitoring activites, which will be conducted in a manner intended to minimize visual impacts. Facilities will be designed to blend with the surrounding terrain to the fullest extent possible. Aesthetic impacts will be limited in duration by prompt implementation of rehabilitation procedures following removal of facilities after completion of monitoring, drilling and other activities.

How do Scales compare with panel recommendations!

F. AERIAL PHOTOGRAPHY AND TOPOGRAPHIC MAPPING

Various photogrammetric techniques will be utilized throughout the course of the program in support of data collection, recording and monitoring activites. These will include photogrammetric techniques to produce topographic maps and use of color, color infrared and false color photography for specialized studies such as photogeology and biological monitoring.

Topographic and photogeologic mapping will be performed on the basis of the initial aerial surveys. Photography for topographic mapping will be done in color on a scale of 1"=1000' while photography for photogeologic work will be done on a 1"=2000' scale. Black-and-white infrared photography will be used to define drainage patterns, strike, and dip and vegetative characteristics.

Black-and-white, color, infrared and false color techniques will be employed for biological mapping at appropriate intervals to monitor seasonal changes in biomass and productivity. Topographic changes on the site may also be recorded by this process. False color infrared will be utilized in the vegetative mapping process, using a scale of 1"=500', allowing for greater detail in interpretation. This technique will be used primarily in summer months (March to October) to identify distribution of plant species and communities and to define their density, phenology, and condition. This will be supplemented by the use of black-and-white infrared photography, which is more suitable for year-round use, to provide an ecological record during the winter months of more dormant conditions.

SECTION VI

OTHER ENVIRONMENTAL STUDIES

SECTION VI

OTHER ENVIRONMENTAL STUDIES

A. ENVIRONMENTAL SITE SELECTION PROCESS

The site selection process for the facilities required to implement the initial exploration and monitoring program will be based on identification of the most environmentally suitable locations for monitoring stations, drill sites, and transportation and utility corridors. This will be accomplished through the use of an overlay technique designed to isolate i) environmentally sensitive areas, ii) environmentally insensitive areas, and iii) neutral areas of uniform environmental character. According to this procedure, a series of overlays is prepared which identify a continum of positive and negative values for various characteristics, such as slope and geologic stability, presence of unique resources such as wildlife habitats, rare and endangered plant species, or archaeological sites, and natural hazard areas such as flood plains.

Specific requirements for different types of monitoring stations and equipment will also be incorporated into the process. Alternate potential spent shale disposal sites will be monitored pending final selection of disposal areas. This selection process in turn will involve consideration of geomorphology, surface and ground water hydrology and other factors. By this procedure, a pattern of possible site and corridor locations may be identified which will allow for minimum disturbance of environmentally critical areas. This same technique can be applied to establish optimum locations for other types of activities as well as waste management areas.

B. WASTE MANAGEMENT PROGRAM

1. SOLID WASTE

Solid waste will be generated during the construction of the facilities required for the environmental baseline study and on-site exploration operations. Debris from clearing and stripping operations (as may be produced from road, well site and facilities construction activities) and drilling mud from monitoring well drilling operations represent the major portion of solid wastes generated during the baseline data collection program. Miscellaneous solid wastes in small quantities such as cans, bottles, paper disposal items and the like will also be generated. Where practical, small items may be stored in collection bins or other receptacles for subsequent transport to an off-site disposal area. Potential on-site and off-site disposal areas may be evaluated and selected, based upon forthcoming surficial geologic and hydrologic data and other information. Methodology may include landfilling and/or burning. However, burning will not take place without first securing a permit from the Mining Supervisor and/or other local regulatory agencies.

2. LIQUID WASTE

A major source of liquid waste may be generated during ground-water pump testing of observation wells. An aquifer under test may contain high salinity water which cannot be discharged to surface streams. Should high salinity water be encountered, a holding pond may be constructed with adequate capacity to contain the water generated during the pump test. At the proper time, relative to on-going nearby aquifer tests, the water in the pond could be filtered through a portable, mobile sand filter (if filtering proves necessary) and reinjected into the proper aquifer. After the water is removed, the area disturbed by the pond could be reclaimed. An alternative method of disposing of high saline water would include demineralizing the water contained in the above mentioned holding pond and discharging the product water to the surface streams. A substantial reduced volume of high salinity water could be trucked to an existing certified disposal area (if such an area exists) or injected into a subsurface reservoir which could be designated for disposal service. A single deep well injection operation could service all of the wastewater disposal needs. Ultimate disposal of all liquid waste will provide for reclamation of the areas disturbed from the construction of holding ponds. All necessary discharge permits will be obtained prior to initiation of pump tests.

3. SANITARY WASTE DISPOSAL

It is not anticipated that any sanitary wastes will be discharged on the tracts during the environmental program, since housing, office and laboratory facilities will be located off-site. The security-first aid trailers will be equipped with holding tanks, and the contents removed to an off-site location for disposal. Field personnel requirements will be served by portable self-contained sanitary facilities provided by a local service company.

C. NOISE MONITORING

Noise levels will be monitored a minimum of twice yearly at selected locations on the tracts, and particularly during peak exploration drilling periods to establish noise level variations between minimum and maximum activity periods during the initial two (2) year baseline monitoring phase. Measurements will be made for db-A weighted amplitudes.

SECTION VII

—

SITE FACILITIES

SECTION VII

SITE FACILITIES

A. SITE PREPARATION AND CONSTRUCTION

(1) It is presently contemplated that temporary on-tract facilities and related construction-installation work necessary for conducting the environmental program will include the following:

- -Water quality monitoring stations
- -Meteorological and air quality monitoring stations
- -Security trailer and first-aid station
- -Drilling rig sites (for ground water exploration program)
- -Power line extensions (to serve monitoring stations, etc.)
- -Access roads

At this time, no office, living, laboratory or storage facilities (other than temporary equipment storage) are planned for location within the tract boundaries.

(2) Minor pads, piers and protective structures will be required for the stream gauging and surface water quality monitoring stations to be located on the White River and tributaries on and adjacent to the tracts. It is presently contemplated that approximately 12 water quality monitoring stations will be installed to provide complete coverage.

(3) Two (2) 100-foot high instrumented meteorological towers and a minimum of eight (8) air quality monitoring stations will be located on or adjacent to the tracts. The towers will re-

quire foundations and guy anchors and level pads must be provided for the stationary air quality monitoring trailers. Sites will be fenced to minimize damage from vandalism.

(4) Electric power service will be extended into the tract where feasible to provide power to the water quality, meterological and air quality monitoring stations, security trailer and first-aid trailer.

(5) A security service trailer and a first-aid station will be located adjacent to the main entry road from Highway 45 into the east boundary of Tract U-b. The security trailer will be approximately 160 square feet in area and the first-aid station will be approximately the same size. A single trailer with equivalent area may be selected in lieu of individual units. These facilities will require a generally level site with adjacent parking space required for 3-4 vehicles. Power for lighting and heating and telephone service will be required.

(6) Level pads will be required for drill rigs during the ground water exploration drilling phase.

(7) It is anticipated that some new road extensions will be necessary to provide year-round access to monitoring stations and drilling sites. However, maximum efforts will be extended to locate these facilities and operations so as to utilize existing roads and trails and minimize the need to extend or augment these routes.

(8) Prior to final site selection for any environmental monitoring facilities, drilling facilities, roads, power lines, or support facilities, the proposed sites and routes to be used for those purposes will be inspected by qualified scientists to assure that no rare or scientifically significant species, objects of historic interest, or special features, such as springs, will be disturbed. The Mining Supervisor will be immediately informed if any such species or objects are found. If it is impractical to relocate proposed facilities to avoid disturbance of the sites, the investigating scientists will delineate methods of mitigating any environmental impacts which might be anticipated as a result of the construction or operation of support facilities. They will also document the nature of the existing environment in order to assist in restoration and rehabilitation of disturbed areas.

Sites for monitoring stations, drill rigs, access roads and power lines will, to the extent possible, be selected to minimize land disturbance and environmental degradation.

B. ACCESS REQUIREMENTS

Access to Tracts U-a and U-b is provided by Utah State Highway 45 from Bonanza, Utah. The road enters Tract U-b on the north and runs diagonally across the northeast corner of the tract. An unimproved road branches off Highway 45 on the northernmost section of Tract U-b and runs diagonally to the southwest corner of the tract. This road enters Tract U-a at the southwestern corner and meanders across the tract, leaving at the southwestern corner. Unimproved trails branch off at several points (see Plate 2).

Needs for access during the exploration period are varied. Included are requirements for vehicular access to drill sites for equipment, materials and operating crews, access for servicing and sampling the various baseline data monitoring stations, and access for personnel and equipment necessary to the comprehensive environmental assessment to be undertaken.

Existing roads will be utilized to the greatest extent practicable to minimize construction of new roads and concomittant grading and land use. Improvement and expansion of the existing road system will be accomplished only to the minimum extent necessary to satisfy the above requirements.

The State of Utah and the County of Uintah maintain the road facility intended for primary use, including snow-clearing during the winter period. It is possible that county jurisdiction and funding will be ultimately extended to service oil shale industry needs, however, such is not anticipated to occur during the initial two (2) year monitoring period.

In the interim, it is planned that the lease operators will extend and augment the state and county maintenance efforts using all-weather access.

Final design of primary service roads, incorporating the use of existing roads alignments and integrating multiple-use corridors to the greatest practicable extent, will be undertaken during the exploration period for submittal with the Detailed Development Plan. The roads and trails will be located, constructed, and maintained in accordance with applicable provisions of the leases. Drainage structures, culverts and erosion control measures will be incorporated for all new and upgraded roads to minimize and control erosion and other environmental damage.

The lease operators intend to restrict on-site vehicle and construction equipment travel to the extent practical to confine such travel to existing roads and trails whenever possible. The principal on-site vehicular activity will consist of the moving of drilling equipment and personnel, the installation and servicing of baseline data collection stations and equipment, and on-site travel of environmental field research teams.

C. CORRIDOR PLANNING

Section 2 of the lease environmental stipulations sets forth requirements for developing multi-use corridor plans for roads, pipelines and utilities on the lease tracts for approval by the Mining Supervisor. The stipulations specify that such plans shall include major design features and proposed plans for the protection of the environment, prevention of pollution, minimization of erosion, rehabilitation and revegetation of all disturbed areas not required in the operation of the transportation system, both during and after construction.

It is intended that the planning and site selection process for such facilities required to implement and support the initial exploration program will involve an overlay technique whereby environmentally sensitive areas (wildlife habitats, archaeological sites, etc.), unstable materials, flood plains and other natural barriers and fire hazard areas are identified and located in the early planning stage. Final siting of monitoring stations, drill sites, and temporary access-utility corridors will then be developed to avoid disturbance of these areas, or acceptable mitigation measures submitted for approval and implemented where significant disturbance is unavoidable.

In the environmental program and related explanation work phase, it is planned that existing roads and facilities will be utilized to the extent possible, in order to defer construction of substance and until after comprehensive planning studies have been made. The advantage of multiple land use through corridor planning vis-a-vis individual route selection for each facility is noted in the lease and has been stressed by the Bureau of Land Management. Planning efforts will be aligned to this concept.

Planning and analysis of multiple use corridors will be a significant element of the Detailed Development Plan (DDP). However, a prerequisite to defining such corridors is the solution of several major questions facing the development, e.g. the availability and location of substantial quantities of power, the major markets for the product(s), and the settlement location of permanent personnel employed by the industry. Following study and determination of these questions, final corridor planning will be undertaken and recommendation included in the DDP.

Initial corridor studies will be complete and comprehensive in nature and detail with all feasible alternatives and routes evaluated.

D. OFF-SITE FACILITIES

As presently planned, office, housing, laboratory and warehouse storage facilities required in support of the environmental program will be located off-site to minimize environmental disturbance on the tracts during the on-going baseline monitoring period.

Field office facilities will consist of mobile trailers providing space initially for approximately 12 environmental scientists and support personnel.

Field laboratory facilities will be provided in a mobile trailer adjacent to the field office for preliminary analysis of water quality samples and preparation and storage of other specimens and samples collected during the program. Approximately 400 square feet of space will be provided. Equipment will include balances, drying ovens, microscopes, laboratory tables and distilled water storage.

Warehousing storage space (approximately 400 square feet) will be provided by a mobile trailer for temporary storage of various samples (soils, drill cores, etc.), monitoring equipment spare parts, and other miscellaneous equipment.

Some temporary living quarters will be provided adjacent to the field office-laboratory facilities for field personnel requiring over-night accommodations near the tract site. Living, sleeping and cooking facilities will be provided for 4 people in a mobile trailer unit. The remainder of the environmental field program personnel will probably be housed in facilities in a nearby town (Vernal, Utah or Dinosaur Colorado) and commute to the site during the initial data collection program.

As presently planned, the field office, laboratory and storage trailer units will be situated at the town of Bonanza, Utah, with field personnel commuting to the site as required.

E. SAFETY, FIRE PREVENTION AND OTHER CONTROL MEASURES

Protective measures for the prevention of air pollution, fire, soil erosion, damage to fish and wildlife habitat, and prevention of health and safety hazards will be employed. Road construction, drill site preparation, and wastewater pond construction are activities which could potentially generate dust pollution. Diligent application of water and possibly other wetting agents may be used to control dust pollution. Measures to protect fish and wildlife habitat are described in Section VIII and erosion control is discussed in Section IX.

It is not anticipated that flammable liquids will be stored on-site during the baseline study phase of the program, as laboratory and chemical storage facilities will be located off-site. Further, fire prevention and safety regulations will be adhered to during all drilling and construction activities. Use of explosives is not anticipated for either the mobilization phase or the implementation phase of the environmental baseline study program.

All drill holes, excavations and other similar improvements will be marked and protected to prevent injury to persons, livestock or wildlife. General public access will not be restricted except in those areas where activities (drilling, earthwork operations, etc.) might present a hazard to the visitor. All operations will be conducted in compliance with applicable federal, state and local statutes, regulations and safety standards.

No open burning is contemplated at this time. If any should be necessary, the required permits will first be obtained.

The conduct of every employee entering the site will be in accordance with good health and safety practices. In the unlikely event that an injury occurs, a first-aid trailer containing emergency medical supplies meeting OSHA standards will be located on-site. In addition, communication equipment which may be used to contact nearby medical facilities and fire stations may be provided at strategic locations. Field personnel will be equipped with mobile citizen's band radio equipment which could be used for establishing contact in case of emergency.

SECTION VIII

INITIAL FISH AND WILDLIFE MANAGEMENT PLAN

SECTION VIII

INITIAL FISH AND WILDLIFE MANAGEMENT PLAN

Definite consideration must be given to fish and wildlife during the environmental baseline study period. This is due to the low man days use in the area in the past which obviously had little or no effect on the wildlife. With the increase of people in the area on a continuing basis and their associated activities, a definite influence on wildlife will occur.

Prior to the initiation of the actual baseline studies, interviews with State of Utah, Division of Wildlife, and Bureau of Land Management personnel will be conducted. Aerial observations and walk-throughs on the site and surrounding areas will also be conducted. Purpose of these preliminary meetings and observations is to help eliminate or minimize possible irreparable damage to the fish and wildlife (especially rare or endangered species) and the associated habitat. Primary emphasis will relate to those sites or areas where the greatest amount of human activity will occur during the baseline study period. This would include, but not be limited to:

1) drilling sites
2) air and water monitoring stations
3) clearings for roads and power lines

A coordinated effort between all agencies and groups involved in the baseline study will be maintained. In some instances alternative sites and designated times for studies will be used to minimize damage to fish and wildlife and the associated habitat.

Key factors to be considered will include primary deer winter range, migration routes and fawning areas. Nesting sites for raptors, especially those not tolerant of mans' presence and activities, such as the peregrine Falcon (Falco peregrinus) will be identified and efforts made to reduce or eliminate activities during the nesting period. The presence of any prairie dog communities which could also support black-footed ferrets (Mustelo negripes) will also be noted. Power lines to monitoring sites will be designed in such a manner as to reduce or eliminate Golden Eagle mortality, especially during the winter months when numerous birds may occupy the area.

As other problems arise or are found to exist during the baseline study period immediate corrective measures will be initiated to eliminate or minimize the problem.

Problems could arise during those periods such as big game and upland game hunting seasons. Direct conflicts between on-site personnel and their associated activities and sportsmen-hunters could occur. Steps will be taken to inform on-site personnel of the seasons and possible areas of greatest hunter activity. The assistance of the State of Utah, Division of Wildlife will be solicited in this effort. The sites will be posted advising the sportsmen of activities in the area and seeking their cooperation in minimizing possible conflicts and dangers.

Methodology involved in establishing baseline data on wildlife will be specifically designed to avoid injury or mortality to the concerned populations. These measures will include, but not be limited to:

1. Use of live traps
2. The use of accepted marking techniques which have been verified as having minimum adverse effect.
3. Consideration of established wildlife movement patterns in design of transportation corridors.
4. Interaction with conservation groups (Audubon Society, Ecological Society of America, National Wildlife Federation, etc.)
5. Reduction of human activity to minimum levels during critical periods (breeding, hatching, etc.).

SECTION IX

SURFACE REHABILITATION AND EROSION CONTROL PLANS

SECTION IX

SURFACE REHABILITATION AND EROSION CONTROL PLANS

A. SURFACE REHABILITATION

The activities discussed in preceding sections will cause minor disturbances on portions of tract surfaces during initial exploratory operations. These disturbances will include:

1) Site preparation for water well drilling
2) Site preparation for water, air quality and meterological stations
3) Soil pits
4) Vegetation plots
5) Road and trail improvements

These disturbances will be quite localized and should not result in major soil erosion and problems. The rehabilitation program will be designed to restore the affected areas to a condition similar to the present. This condition should be compatible with undisturbed adjacent areas, with soil erosion and water pollution minimized or avoided.

It is expected that water will be brought to the surface where core holes are drilled and tested. This water will be confined and prevented from uncontrolled flowing on the surface of the tracts. Drainage ditches and culverts will be constructed to reduce erosion from road improvements. Mulching, fertilizing and reseeding of all disturbed areas will begin as soon as construction improvement work is completed.

Adequate rehabilitation of disturbed areas will require knowledge of existing community types and general site conditions before the planned activities occur. This is the primary purpose of the pre-exploration environmental investigation. These initial studies, along with the detailed baseline monitoring program activities, will provide the information necessary to restore the disturbed sites to a condition similar to the present.

Methodology and plans for surface rehabilitation will be submitted to the Mining Supervisor for approval. Concerned government and local agencies whose expertise in land reclamation is widely recognized (Bureau of Land Management, Soil Conservation Service, etc.) will be consulted throughout the program.

B. EROSION CONTROL

Prior to implementation of the environmental monitoring program, the erosion potential of the existing undisturbed soils and subsoils will be assessed. Reconnaissance and monitoring activities will cause increased use of existing surface facilities and impacts of these activities will be evaluated. Dust control measures may be necessary on present and new roads and trails; existing roads may require upgrading to accommodate increased traffic. The use of tracked and wheeled equipment may increase the potential for erosion in some areas. Protective measures against flash floods and mudslides will be provided as necessary. These measures are expected to include sufficient culverts, berms, and grade control.

Grading plans for drill pads and monitoring stations will be designed to reduce the effects of erosion. Impacts which occur from water well drilling and trenching for soil samples will be mitigated by surface rehabilitation procedures. Buffer strips (200 foot minimum width) will be maintained on either side of streams, lakes and rivers as required. Cut and fill operations in proximity to streams which might result in siltation or accumulation of debris will be avoided.

Methods of controlling erosion during operations and reclaiming the disturbed areas will include mulching and reseeding of disturbed areas (graded pads, slopes, etc.) with native ground cover species. Interim measures will be necessary to minimize erosion until plant growth can be established.

SECTION X

SCHEDULE OF MANPOWER REQUIREMENTS

SECTION X

SCHEDULE OF MANPOWER REQUIREMENTS

The following table provides an estimate of on-tract manpower requirements over the initial two (2) year environmental baseline data collection and monitoring period. Not all of the personnel will be on-tract at any given time, although they will be executing assignments in the area that directly relate to the program. As will be noted, the peak period of activity occurs in the 3rd and 4th quarters of 1974 when sites are being prepared, equipment installed and other initial baseline data is being collected.

TABLE 2

PROGRAM SCHEDULE AND MANPOWER REQUIREMENTS

(ENVIRONMENTAL PROGRAM)

Year	1974				1975				1976			
Quarter	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
BIOLOGY AND SOILS		(8/1)										
Average On-Tract Employees			6	6	4	4	4	4	4	4	4	4
METEOROLOGY AND AIR QUALITY		(8/1)										
Average On-Tract Employees			5	3	2	2	5	2	2	2	2	2
SPECIAL ENVIRONMENTAL STUDIES		(8/1)										
Average On-Tract Employees			4	4								
SURFICIAL GEOLOGY AND HYDROLOGY		(8/1)										
Average on-Tract Employees			18	10	5	4	2	2	2	2	2	2
SUPPORT ROADS AND FACILITIES		(8/1)										
Average On-Tract Employees			13	5	4	4	3	3	3	3	3	3
TOTAL ON-TRACT EMPLOYEES			46	28	15	14	14	11	11	11	11	11

Form 1279–3
(June 1984)

BORROWE

TN 859 .U82 W445

Partial explorat
environmental b

DATE LOANED	BORROWER

USDI – BLM